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The Journal
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Vol. XIV. No. 1

Bee-Keeping as a Subsidiary Occupation for the Cultivators in the Mysore State

BY

T. V. Subramaniam AND B. Krishnamurti

Bee-keeping in a primitive state has been in existence in the western parts of the Mysore State for a very long time, particularly in the Malnad parts of Kadur and Hassan Districts. Apart from keeping a few pots of bees in their houses, more or less as a curiosity, the villagers do not pay them any attention but procure their chief source of honey from the combs of wild bees found in plenty in the forests; thousands of pounds of this honey are being exported in kerosene tins annually to places outside the State in addition to a large quantity which is distributed to different parts in the State for sale in the bazaars. This honey is very impure, extracted as it is by the inhuman methods of burning and killing millions of bees and crushing large numbers of the young bees in different stages of development during the process of squeezing the wax combs. This honey can never be used for medicinal and other purposes where pure honey is required. The only source of pure honey in the State is that imported from

foreign countries, *viz.*, Europe, Australia, New Zealand and kept for sale mostly by European firms. Considering that we have extensive areas of natural and perennial green vegetation in addition to large areas of cultivated crops with honey-yielding flowers and bees as well for rearing purposes, it is a pity that attention is not paid to the production of pure honey by improved methods of rearing bees.

Rearing bees as a sole profitable industry is not to be thought of by the bulk of our cultivators in the State ; it is not the intention of this publication to advocate Bee-keeping as a profitable industry, but it is certainly possible for a large number of cultivators to take to bee-rearing with one or two improved hives as a *subsidiary* occupation. The initial outlay is negligible, not even a fourth or fifth of the value of a very ordinary pair of cattle used for agricultural purposes. There are practically no maintenance charges and the work of cleaning and attention requires only a few minutes of time twice a week for each colony of bees. The cultivator is more than recompensed for the initial outlay and the care bestowed on a colony of bees by the appreciable returns, in the form of pure honey and wax. If only a very small percentage of the cultivators in the villages in the State take to keeping one or two colonies of bees each and pay some attention to the proper care and extraction of honey, etc., by the improved methods, not only will there be no dearth of pure honey for local use, but there will be enough left over for export to places outside the State. Taking up of improved bee-rearing by the cultivator as a subsidiary occupation will naturally tend to minimise the inhuman methods adopted now in getting honey from the wild bees in the forests.

Our Honey Bees and Particulars about Them.

We have three kinds of honey-gathering bees in the State and these are (1) *Apis florea* ; (2) *Apis dorsata* ; and (3) *Apis indica.*

1. *Apis florea.*—This is a small bee that builds a single comb about six inches by twelve inches and usually hangs it from the twig of a small tree or bush. Its store of honey is very little and it is not domesticated.

II. *Apis dorsata.*—This is the biggest of the honey bees and is called the "Rock bee". It generally builds its comb in inaccessible overhanging ledges of rocks or high cliffs and tall trees. In towns

it builds its comb in inaccessible portions of tall buildings and towers. Like *Apis florea*, this also builds a single tapering comb. The latter is about a foot broad and sometimes 5 to 6 feet in length. Some of these combs are known to yield 50 to 60 pounds of honey. It is honey from these combs that is very largely collected in the forests and sold in the local bazaars. This bee is very fierce and when disturbed it is often known to chase men and beasts for long distances in forests and sting them. Owing to its ferocious nature and its habit of building only a single comb of very big size, attempts have not been made to domesticate this bee.

III. *Apis indica.*—This bee is smaller than the above and builds its combs in several parallel rows in hollows of big trees, cracks in rocks and old walls and old and deserted underground portions of whiteant hills. It is this bee that is being reared in pots by the cultivators in the Mysore Malnad and it has been found possible to rear these in improved hives similar to those found in foreign countries but as these bees are smaller than the foreign, hives suitable to their size are provided. There are two kinds of these bees found in the State. One is the dark variety found in the Malnad parts and another reddish-yellow in the Maidan parts.

There is a fourth kind of bee, very small in size, *Melipona* sp., building their nests in cracks in walls generally. The combs are built of resinous matter; these are commonly known as "*Dammer bees*". Although very little honey is obtained, it is highly valued in Ayurvedic medicine.

Members of a Colony of Bees.

Before attempting to keep a colony of bees it is essential to have a knowledge of the different members comprising it and to differentiate them. There are three castes of bees commonly met with in a colony; they are (1) The Queen; (2) The Workers; and (3) The Drones.

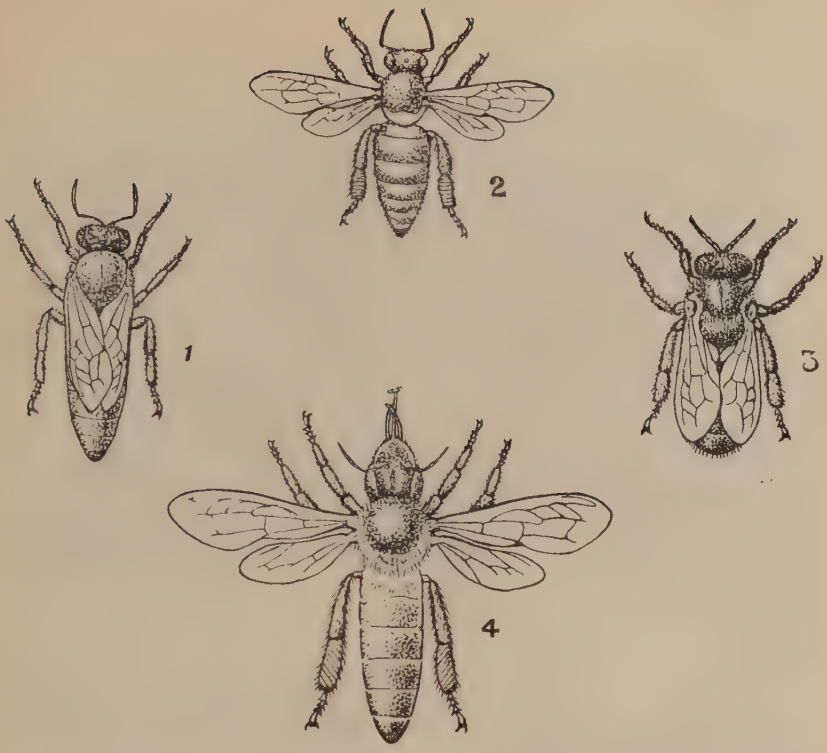
(1) *The Queen.*—This is the biggest of the bees in a colony and will generally be found singly in a colony. It is the only fully developed female bee in a colony and the only one capable of laying large number of eggs. It is easily distinguished from the others by its elongated fully developed body, by its small wings which are not in proportion to the size of the insect, by its incompletely developed mouth parts and the pollen gathering brushes on the

hind pair of legs. The cell for the queen is built generally on the edge of a comb. It is placed vertically and is easily made out by its large size and elongate shape.

The queen lays eggs continuously and thus increases the number of bees in a colony. The queen bee never leaves the colony except when it has to mate with the male bee which happens only once in its lifetime before the establishment of a colony. A queen bee generally lives for about 5 to 6 years but after three years it does not lay many eggs.

(2) *The Workers* (Undeveloped Female bees).—These are the smallest of the three kinds of bees and form the largest number in a colony. These build the combs, gather nectar and pollen from various flowers and store them in the cells, feed the young, guard the colony, attend to the sanitary condition of the colony and thus are always engaged in work in the colony and outside throughout the day and night. They know the needs of a colony and build queen cells in the combs as the necessity arises. The queen lays eggs in these cells also and by proper feeding of the young ones hatching out from these eggs with a special food, queens are produced. The worker cells are the smallest in size and are found in the greatest numbers in a comb. It takes about three weeks for the winged workers to emerge from the cells after the eggs are laid. The workers have offensive and defensive organs in the shape of a sharp sting placed at the tail end of the abdomen. They live only for a short period of about 6 weeks.

(3) *The Drones* (Male bees).—These bees are darker in colour and slightly bigger in size than the workers. Their cells in a comb are easily made out by their bigger size, their slightly roundish shape and their darker appearance than the worker cells. These do no work and generally form a much smaller number than the workers. They are in the colony for the purpose of fertilizing the queen. By the buzzing noise they produce in flight, their size and colour, they can be very easily made out in a colony. During a poor honey season and scarcity of honey in the combs, the workers mercilessly kill these bees and it is a common sight to find number of these dead bees lying outside a hive in certain seasons. These bees are not provided with an offensive or defensive organ similar to the workers.

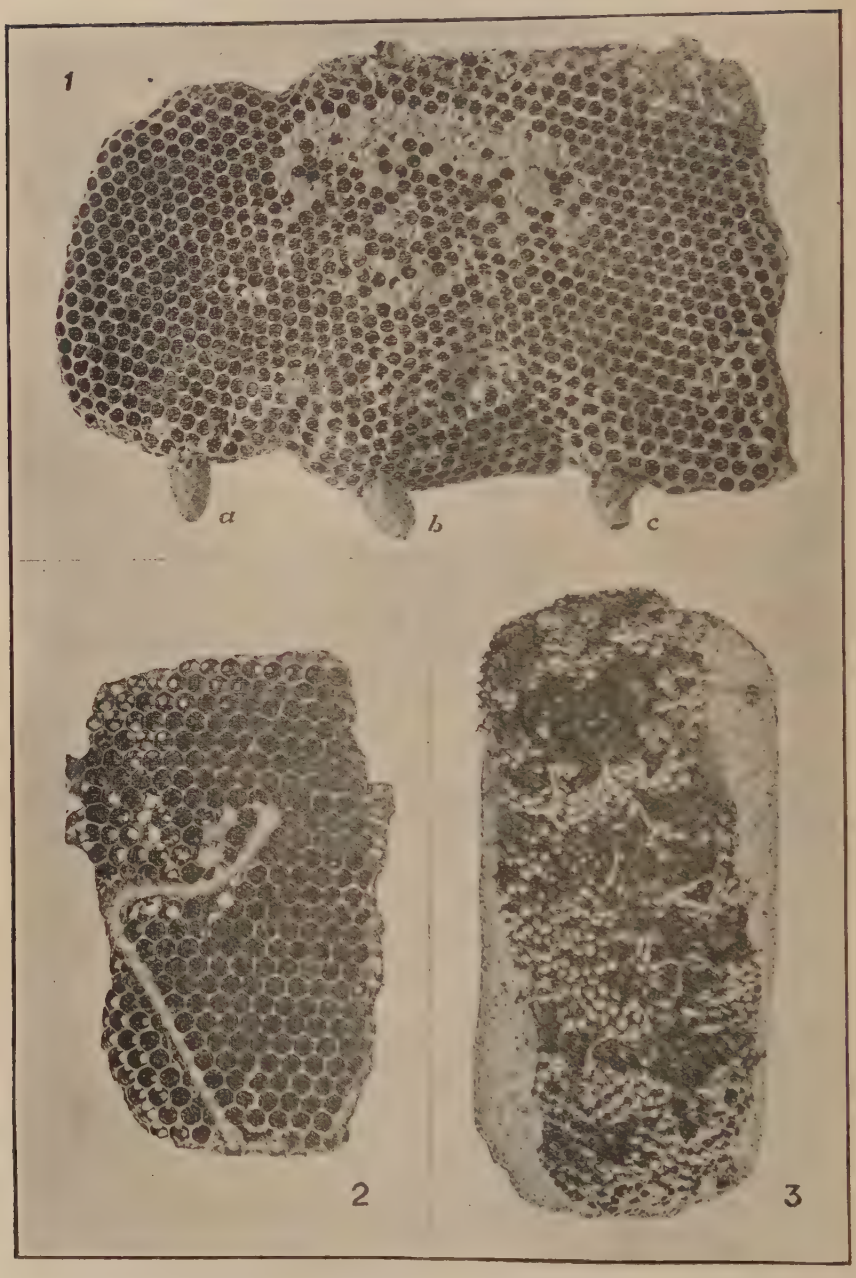


1. The Queen Bee. 2. The Worker Bee. 3. The Drone Bee. 4. The Rock Bee.

a. Caterpillar of the Wax-moth.

b. The Wax-moth.

1. A Brood Comb with three queen cells—*a. b. c.*



2. A wax comb, webbed and partly eaten away by the caterpillar of the wax-moth.

3. A comb of the small bee—*Melipona* sp.

Local Bee-Rearing Methods.

The swarming and formation of new colonies of bees take place in Nature from the end of the cold season up to the end of summer, *i.e.*, from January to May. At about the commencement of the season, some of the cultivators in the Malnad areas leave wide-mouthed small earthen pots, each with a few small holes on the sloping sides near the mouth of the vessel, underneath thick bushes, near the hollows of trunks of big trees, near neglected whiteant hills, etc., in the forests. After a short period many of these vessels are found occupied by colonies of bees. These are removed carefully by the cultivators to their houses late in the evenings, when the bees are all inside and are kept inverted in rows on a plank hung up by means of ropes generally against the walls of their houses or cattle sheds. Sometimes the verandahs at the back or front of their houses or the beams underneath the gables are also made use of to keep the pots. After this is done no attention is paid to the pots for a period of a month or two when the pots are turned over, the bees are quietened to a certain extent by blowing into the pots with the mouth after chewing a bit of garlic or onion.

The combs with honey are broken and placed in a piece of cloth and squeezed ; the pots are again left in their old places. This method of extracting honey takes place off and on. It is a common practice amongst the cultivators in the Malnad to break a few honey-combs and give them to distinguished visitors or guests in their places. The bees are hard put to find enough honey, pollen, etc., to rear out the young ones and to tide over the monsoon months and build a few new combs. But the colony in pots is only thinly populated and very weak so that the enemies of bees, particularly the *wax-moth*, gain entrance into the hives and the bees are found very often deserting the pots. The quantity of honey obtained by this method is very small and it is impure in quality. The people later resort to the method outlined above for catching swarms of bees every year.

Improved Method.

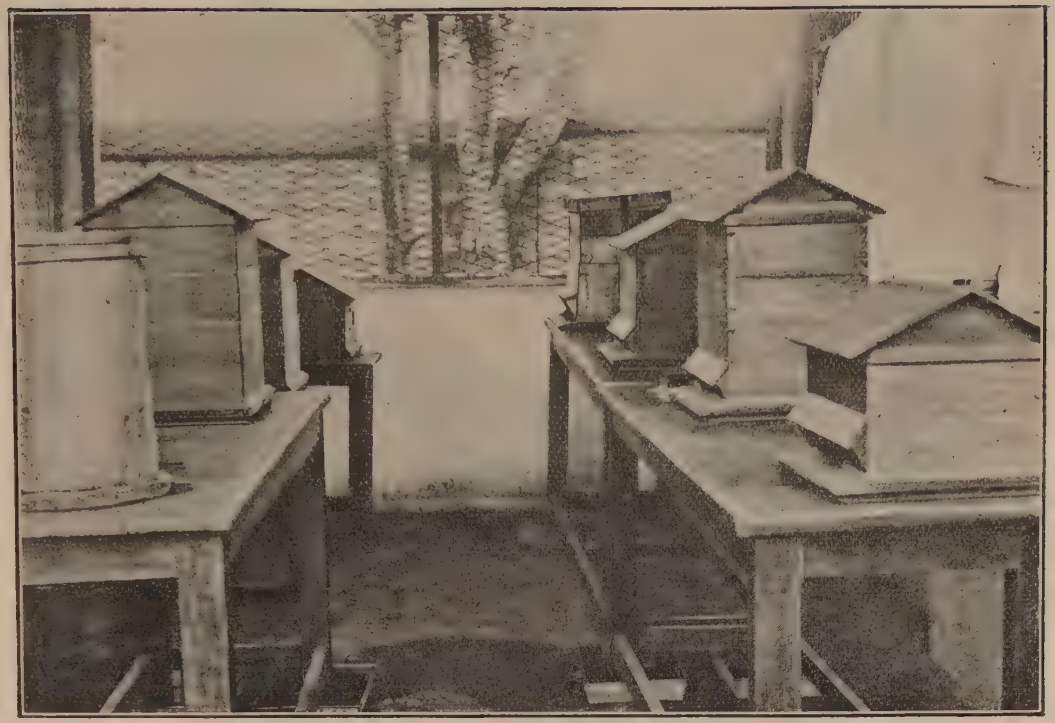
By this method the bees are given more room so as to allow ample provision for increase of their population and better sanitary conditions. It also provides for the building of combs of a standard

size. It gives facilities for the frequent inspection of the individual combs with bees, without disturbing the mass of other bees in the colony, and for the removal of the combs with honey for extraction without in any way interfering with the combs in which the young ones are reared. The combs so emptied of their honey can be restored without in any way damaging the combs so that the necessity of preparing fresh quantity of wax and the construction of new combs by the bees is avoided and the energy spent in the preparation of extra wax by the bees is diverted to gathering and storing honey. This allows for the gathering of more honey in a shorter time than by the local method. The combs first built by the bees can then be used repeatedly. Last but not the least in importance is the very long period the bees continue to remain in a hive in a very healthy and prosperous condition in the improved bee-hive.

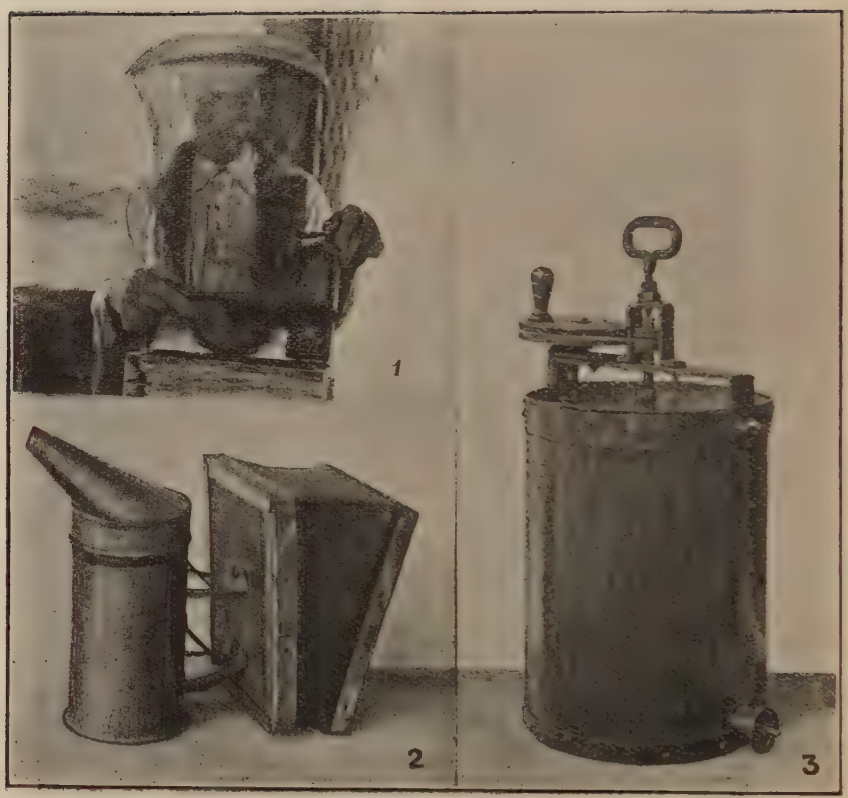
Box Hive.

This is a wooden box made of teakwood (preferable to other woods) and consists of a bottom board 13″ long by 13″ broad provided with small legs of about 6″ height on the four corners. On this is placed a box measuring 11½″ long, 10″ broad and 6″ high open at the bottom and top. At the middle of the bottom of the box on the front, is a narrow slit about ¼″ in width, which forms the entrance or exit for the bees. There are other boxes without top or bottom of the above measurements excepting the height which is only 4″, capable of being arranged one on the top of the other when required. A number of frames are arranged close together in these boxes with enough room in between to allow for the free movement of the bees inside. These frames are 9½″ long and 5½″ high for the bottom box and 3″ high for the others. The bottom box is called the *brood chamber* where the young ones are reared, and the others are *honey chambers* or *supers* where honey is stored. The top of the boxes arranged one over the other is provided with a roof. It is very important that all the boxes and the frames in an apiary should be of the same measurement to enable interchange of the frames and supers when needed.

The other appliances needed for starting an apiary according to modern methods are (1) veil, (2) gloves, (3) smoker, (4) honey extractor, (5) queen excluder, (6) bee escape and (7) comb foundation.



The interior of part of the apiary attached to the Laboratories of the Agricultural Department, Bangalore.



1. The Veil. 2. The Smoker. 3. The Honey-extractor.

(1) *The veil* is made of fine mosquito netting and put on over a hat worn on the head to protect the face from the stings of the bees. It is very necessary for a beginner to use this in different operations connected with bee-rearing. After the use of this for some time, it may not be necessary to use the veil as the bees get accustomed to the person and do not sting.

(2) *Gloves* made of chamois leather or rubber or some thick cloth with long sleeves are also necessary for a beginner in handling bees.

(3) *The Smoker.*—This is a cylindrical tin vessel about 6″ long and 2½″ in diameter closed at the bottom and having a lid with a snout on top. A perforated metal disc is kept fixed about 1½″ from the bottom of this vessel. From underneath this disc a small ½″ tube, 2″ in length is led out against a pair of small hand bellows, so fixed that when the latter are worked, air is forced into the cylinder through the tube. Some bits of rags are placed on the perforated disc and lighted, and the bellows worked, when smoke issues out in puffs from the snout on the lid.

Bees are easily subdued by smoke, and this fact is taken advantage of in the use of the smoker. When an examination of the hive is necessary, the smoker is employed to quieten the bees.

(4) *Honey Extractor.*—This is a machine which is used in extracting honey from the combs built on the frames in the honey chambers in a hive, without in any way damaging the structure of the wax combs. The honey combs with frames are removed from the hives and put into the machine ; a few turns of the handle empties the cells of their honey and the latter flowing out of the vessel is collected in receptacles. The honey obtained by this method is very pure and untouched by hand and the combs emptied of their honey are replaced in the hive.

The first four mentioned above are absolute necessities for a beginner to start a colony of bees.

(5) *Queen Excluder* is made of a very thin sheet of metal with a number of holes big enough to allow the workers only to move from one box into another but prevent the queen from doing so. When the brood chamber is full of young ones, the queen occasionally climbs up to the honey boxes and begins laying eggs in the combs and the young ones are reared there. To prevent this the sheet of

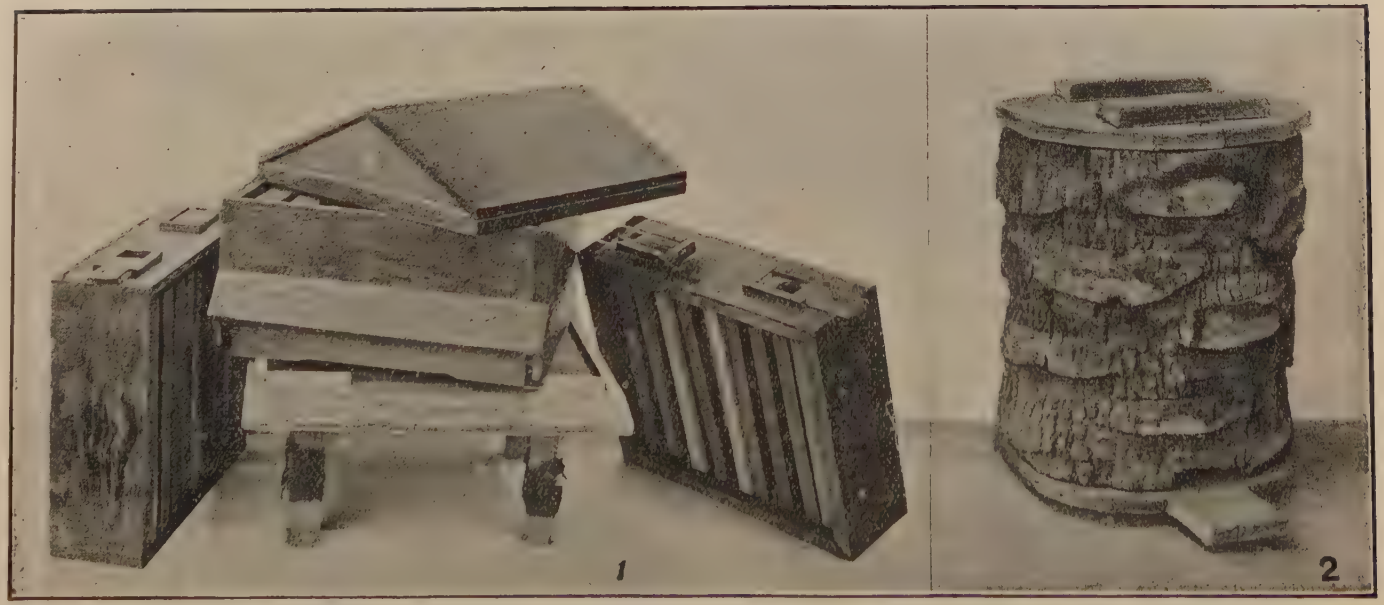
queen excluder is placed between the brood chamber and the lowest honey chamber.

(6) *Comb Foundation.*—This is a sheet of wax on both sides of which are pressed the impressions of the cells of the same size and number per square inch found in a natural comb. This sheet is cut into the size of the frames inside the box-hive and fixed to the frames. The bees are enabled to build the combs on these models quickly without waste of time and effort. It is however found, that our bees do not take to the foundation at all the seasons and as quickly as the bees in the West do.

How to start a Colony of Bees.—As has been stated in the beginning, bees can be collected in earthen pots kept for the purpose in different situations in the forests. Instead of the earthen pots decoy hives made of hollowed pieces of date palm stems about two feet long can be used. These are closed at the ends with circular planks. A elongate small opening is provided on the stem close to the plank on one end to enable the bees to get in and out. These *decoy hives* are tied firmly to the branches of tall trees during the flowering season, generally in February to April. Bees are found to occupy these in a short time. About a week or two after the occupation of the decoy hives the latter are brought home late in the evenings when the bees are all inside and left in or near the spot meant to be the permanent abode of the bees for another two weeks. Then the bees are transferred from the decoy hive to the improved hive in the following manner :—

The circular planks are taken out, a very small quantity of smoke is blown in to quiet the bees and make them cluster to one side ; the combs with the brood of young ones are cut out and tied carefully by means of plantain fibre to the frames in the brood chamber of the improved hives and the frames arranged parallel to one another. The combs with honey are cut and tied to the frames in the honey chamber, and finally the bees are shaken into the hive and the cover or the roof is put on the top. The hive with the colony of bees is then placed on a bench or platform about three feet high and the legs of which are protected from crawling ants etc., by placing small basins of water underneath. The hives with the bees should be at least 3 feet away from the walls of buildings to prevent lizards from getting on the platform or bench.

1. Pot used to keep bees in the Malnad.
2. The several sections of the improved hive.
3. The upper surface of the brood-chamber of the improved hive showing bees at work.
4. Extraction of honey by means of the extractor.



1. The several parts of the improved bee-hive box.

2. Decoy hive made of date palm stem.

The above is the easiest method of hiving a colony of bees. In case a colony of bees is spotted in a neglected whiteant hill or in the hollows and cracks in old walls, etc., the procedure is to dig out slowly all round. The bees are smoked a little when they all cluster to one side of the cavity. The brood-combs and the honey-combs are then cut out with a knife and carefully tied to the honey and brood frames, and arranged in the box and the bees are finally gathered by the hand or scooped out and put into the box and the top cover put on. Sometimes during this operation the bees fly away and cluster round the nearest branch of a tree or bush when the latter is gently broken and the bees are all bodily brushed into the box. When once the queen bee is in the box, all the members of the colony remain in that box but in case the queen bee has failed to get into the box along with the others but remains in the cavity in the earth or on the branch of the tree or bush, the bees put into the box-hive leave the box in a body and cluster round the queen bee wherever it happens to be.

Where to keep the Hives.—The hives should be entirely out of reach of children, dogs, cats and monkeys. Monkeys are often most curious as to the contents of the hive and they can do a lot of harm, by way of mischief. A shelter from excessive rain and the strong afternoon sun, should always be provided. While in the Maidan parts of the State, a hive can conveniently be placed under a shady tree, in the Malnad parts, protection from the monsoon rains is very essential.

After-care and Management.—The hive will have to be examined at least twice a week and the bits of wax dirt, etc., found on the bottom board will have to be cleaned and the water in the basins renewed often. This removal of the bits of wax dropping down to the floor of the hive during the construction of the combs by the bees is very important, for there is a very bad enemy of the bees in the form of a moth called the *wax-moth* which lays eggs on the wax and the caterpillars hatching out of these eggs feed and develop on the wax-combs and destroy the combs by eating up the wax and webbing tunnels all about the combs. This makes the rearing of the young ones impossible; when once this enemy gains a hold in a hive, the bees desert the hive in a short time. It is also necessary to lift the top cover of the hive once

a week and look into the box from above in order to locate the joining of the several frames by irregular building of the comb by the bees; this is the direct result of having more space between the frames than is actually necessary for the worker bees to move about freely. The bees always want to use up any extra available space inside the hive for building the comb. The frames joined have to be separated by cutting out the extra comb by a sharp knife taking care not to kill any bees in so doing. They are then to be arranged properly with no more space between than necessary. If the colony is poor in numbers and the brood-chamber seems too big and spacious, the extra space can be screened off by a plank of the size of the interior of the brood-chamber. The greater the unused space inside, the less warm will be the surroundings which is not quite conducive to the well-being of the young ones.

Whenever handling of the hive is undertaken either for the purpose of cleaning the bottom board, cutting out the extra irregularly built combs and setting the frames in proper position or lifting out the frames with combs and bees for locating the presence of the larval webbing of the wax-moth, the queen cells, or removing the honey-combs for the extraction of honey it is very essential to carry out the different operations with great care. The movements of the hand or knife have to be very gentle and slow so that the bees do not feel disturbed or excited and no bees should be crushed; nothing irritates the bees in a colony more than the crushing of a fellow-worker. When several bees are accidentally killed panic soon spreads and the person handling the hive is attacked viciously and in the event of his not being fully protected, stung in many places. In these cases several hours may be necessary for the bees to settle down quietly to their normal activities. The gentler the movements of the person operating the hive, the greater will be his success. Anything and everything that is likely to upset the even tenor of the life of the bees in the hive must be scrupulously avoided and in fact to manage bees properly one must study their habits and dispositions. This takes time but it is time well spent. One essential principle in handling bees is to be the master of the situation.

Honey Extraction.—Generally honey is ready for extraction in a hive, twice a year, *viz.*, March to May and September to

October. From a minimum of 15 lbs. to a maximum of 25 lbs. has been obtained per year from each colony of bees kept in improved hives.

When the cells of the combs in the super or honey-box are found to be closed by a thin wax cap, they are to be taken as full of honey which is the surplus over and above the needs of the bees themselves. But an interval of 8 to 10 days will have to be left before the actual extraction of the honey; for, sufficient time has to be allowed for the proper ripening of the honey inside the cells kept sealed by the bees. There is a tendency for the honey extracted too soon to get sour but too long an interval should not be allowed either. The combs are taken out carefully one by one, and the bees clustering on them, gently brushed back into the box with a broad and soft brush. Each comb is then held slantingly by the left hand on a convenient support and with a sharp knife in the right hand, the caps of wax, sealing the individual cells, are removed.

The sharp edge of the knife is slowly passed upwards from the lower end of the comb, taking good care that only the outer cell-caps and not portions of the cells themselves are removed in the process. Only the cells on one side of the comb have to be uncapped at a time. The other side has to be so treated after the honey in the uncapped cells has been completely extracted. The cells on both sides of a comb must never be uncapped at the same time.

The frames with the combs are put in the extractor two at a time in such a manner that the sides with the uncapped cells face the inner surface of the extractor. A few turns of the extractor handle empties the honey from the cells. This operation is repeated until the honey from all the combs is extracted. The honey first thrown on to the inner surface of the extractor, gradually trickles down to the bottom from where it can be let out through a small tap into clean and dry bottles. The frames with the combs intact are later put back into the hive. Care should be taken not to extract honey from all the frames, particularly when it is done late in the season before the monsoon rains begin as otherwise in the rains the bees will not be able to gather honey enough and will have to starve and thus the colony may get impoverished.

The Maximum Honey Flow.—The honey flow season—February to May of each year—is the most important when the brood-combs

will have to be carefully examined often at least once a week frame by frame. Additional superboxes will have to be placed now on top of the others to give more room. It is during this season that the population in a hive is at its maximum, generally new queen cells are built and queens reared.

Swarming.—Swarming or the desertion of the hive takes place now. This is the method of multiplication or the establishment of a number of new colonies in Nature. Before the new queen or queens emerge from their cells the old queen with a large following of workers and drones swarm away from the hive, after consuming as much honey as possible, to establish themselves in suitable places elsewhere. During the weekly examinations of the hives at this time, if new queen cells are found it is of utmost importance to destroy the queen as well as the drone in their respective cells, in which case the old queen and the bees continue in the same hive. The frame bearing the queen cells may also be placed upside down whenever the queen cells are noticed. When the workers finding the queen cells on the top of the frame inverted they kill the new queens in the cells. Instead of hives with "Shouldered frames" (Langstroth) which cannot be reversed, one with reversible frames (Danzenbaker) can be used for this purpose. As congestion in the brood-chamber often initiates the construction of queen cells preliminary to swarming, it is important to remove one or more brood-combs from the brood-chamber and replace them with empty combs or frames with comb foundation, while the brood-combs themselves are introduced into other hives which are normally weakly populated. By timely attention to the above during this season and by giving plenty of room and air when the population in a colony is at its maximum, the swarming can be prevented and a hive may be kept going for a fairly long time.

It is during the swarming season that advantage is taken of the presence of a number of queen cells in the hive to rear queens artificially and also to increase the number of hives, instead of depending upon natural swarms for this purpose. This is also the season when queen-rearing is done.

Feeding the Bees.—This is never meant to be undertaken as a common practice of supplying bees with food. In the normal course, bees do not require to be artificially fed; so long as plenty

of honey-yielding blossoms are available in the neighbourhood, the bees easily gather more than enough food. Only during the periods of minimum honey flow in nature and during the monsoon months in the Malnad tracts, when the bees do not find sufficient quantities of nectar to gather or find the weather conditions not quite suitable for making frequent trips outside the hive, should feeding them artificially be thought of. But in the case of a colony which has enough storage of honey in the hive itself, left over, every time extraction of honey is done, no extra feeding at all will be necessary even during the heaviest monsoon months. It is of course to be understood that the surplus honey in the hive should never be removed entirely, small amounts should invariably be left over for use by the bees themselves, during the periods of scarcity.

Feeding is therefore meant essentially to prevent starvation and promote and stimulate vigorous breeding on the part of the queen in order that the strength of the colony should be maintained at a fairly high level during unfavourable seasons. It is important that the operation should be begun at the right time and suspended, also at an equally suitable moment. If the colony is left to starve for some time and feeding undertaken quite suddenly and on a lavish scale, the bees get tremendously excited and require days to settle down. Just before the beginning of the scarcity of honey in nature, feeding is to start gradually and must cease also gradually towards the end. The cheapest and best form of food is a syrup made from white granulated sugar. Two parts of sugar to one of water should be used. The water is slightly warmed before putting in the sugar and the temperature of the solution is gradually raised to boiling and maintained at that stage for a couple of minutes; the solution is to be removed thereafter from the fire and cooled. Great care is to be taken not to scorch the sugar. The solution is allowed to boil only after all the sugar has entirely dissolved in the water, otherwise the sugar gets charred and by feeding on this syrup the bees get ill.

Of the several methods of feeding the bees the simplest needs to be mentioned here. Clean an empty cigarette tin with hot water till the smell of tobacco entirely disappears. Wipe the interior dry with a clean cloth. Small holes with a diameter less than a fourth of an inch have to be made in the lid (also thoroughly cleaned

and dried before). Small wicks of twisted cotton with one end thicker than the other, are then introduced into the holes, so that the thicker ends are tightly held in position on the inner surface of the lid while the thinner and tapering ends project outwards. The tin is then three-fourths, filled with syrup, the lid fixed on and the whole inverted and arranged on the frames in the box. The syrup gradually trickles down to the tips of the wicks and collects there in the shape of tiny drops, which the worker bees find very convenient to suck and later store in the cells.

The syrup should not be left in the tin for more than two days together; otherwise it will become sour.

Cost of articles necessary for bee-rearing work :—

		Rs.	a.	p.
1.	Veil—made of mosquito netting	1	8	0
2.	Gloves—made of thick canvas	2	8	0
3.	Smoker	2	8	0
4.	Extractor—small size	5	0	0
5.	Wax Foundation 1 lb.	2	8	0
6.	Improved Bee Hive—made of teak wood having three storeys	7	0	0
		or		
		8	0	0

Enemies of Bees.—The bees in strong and powerful colonies are able to defend themselves from their enemies, but it will, often, be necessary for the bee-keeper to exercise care, frequent examination and clean handling of the colony to keep a large number of them in check.

Wax-moth.—This is decidedly the worst enemy and the caterpillar of this moth is the destructive agent. The adult moths lay tiny eggs on the surface of the combs and bits of wax either sticking to the corners of the frames or lying about on the bottom board ; the caterpillars hatch out and begin feeding on the wax-combs under cover of their tunnels made of silken web. A few caterpillars are able to destroy a great portion of the combs. The bees, specially if they are poor in number, do not take long to desert the hive. The best method of preventing the caterpillars from establishing themselves in the hive is to carry out a thorough cleaning of the interior of the hive at least once a week. The webbing of the caterpillar is very easily seen against the yellowish colour of the

wax or the brown surface of the wooden structures of the hive and is to be removed entirely. The corners and joints of the frame work are to be thoroughly searched and the rough edge of a knife passed back and forth there a number of times in order to crush small caterpillars hiding. In cases of bad attack, the infested combs are removed and fumigated with fumes of sulphur in air-tight box and removed and melted into wax.

Ants.—Several species of ants, both red and black, are occasionally a menace in the apiary. The best way to prevent the ants from reaching the hives is to have the legs of the stool or bench on which the hives are arranged, standing in trays of water which require to be renewed often. Clean water in the trays also provide the bees with enough of water that is required by them. The trays kept in the open or under the shade of trees, get leaves and small twigs into them ; unless they are promptly removed, the ants use them as convenient floats with which to reach the hives. It is always best to use hive boxes, whose bottom boards are raised by means of legs about half a foot in height, so that the prevention of ant trouble becomes easy.

The bees are also subject to occasional attacks by yellow jacket wasps, one or two varieties of (Reduvid) bugs, and some lizards and frogs.

Conclusion.

It is hoped that this article will give an impetus to a large number of villagers in the Maidan areas of the State to start Bee-keeping as a subsidiary occupation and the bee-keepers of the Malnad areas to take to improved methods of bee-keeping instead of still continuing it in the old method. Information on other details not included here may be obtained by intending bee-keepers or those that have already been rearing bees from the Entomologist, Department of Agriculture.

Garlic Cultivation in Hassan Taluk

BY

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This crop is extensively grown in the black soils of Dudda and Salagame hoblies of this taluk which is a purely Maidan tract with an annual rainfall varying from 24 to 28 inches.

The area under this crop is more than 3,000 acres each ryot reserving at least 2 acres for this purpose. This crop is grown successively both in the Mungar and Hingar seasons for two or three years continuously. Two crops of paddy are afterwards taken. This crop does not require so much water as does paddy. And as it matures in about $3\frac{1}{2}$ or 4 months it is also grown in other places which command irrigation facilities.

Soil.—The black type of fertile, retentive soils with a slightly sticky nature are considered the best. Clayey soils which are too sticky are unsuitable for the crop.

Preliminary Cultivation.—Generally four ploughings are given with a country plough. The halube or blade-harrow is then worked twice or thrice so that the land is levelled, roots of weeds turned out to the surface to get dried and the clods disintegrated and made fine. After the land is thus prepared it is divided into a number of plots each at a distance of $5\frac{1}{2}'$ to the other, with shallow drains in between them which are termed '*parees*'. Drains are opened out to facilitate the passage of the excess of water during rains, to prevent the water logging and also to check surface soil being washed away causing erosion.

Manure.—Mostly cattle manure is used. The use of artificial manures has not come into vogue as yet. Only the mungar crop receives about 8 to 10 cart-loads per acre of cattle manure combined with about 50 cart-loads of tank silt. The latter is applied before the seeds are sown. In places where silt is not available red earth is used. The ryots are of opinion that the residual effects of manure and silt applied to mungar crops will be sufficient for the hingar crop also. Thus the expenditure on account of manure for the hingar crop is considerably minimised.

Sowing.—8 maunds of seed bulbs are required for one acre. Generally 100 seers of well-dried bulbs weigh 5 maunds or 240 lbs. Good bulbs of large size are chosen for seed purposes and preserved. Some few days prior to sowing they are dried in the sun for 2 to 3 days and trodden well so as to separate the bulbs from the outer cover. These are afterwards winnowed and the light and poorly developed seeds are eliminated as far as possible.

The seeds thus selected are broadcasted sparsely in 'patas' or plots. Halube is then passed to cover the seeds. Immediately afterwards an irrigation is given. Germination could be noticed clearly about 15 days after the sowing. Any patchy growth observed is filled up by planting seedlings of 15 days old removed from places of thick growth. Generally mungar crops are sown between Bharani and Krithika rains while the hingar crops are sown between Magha and Chitta.

After Cultivation.—After this one irrigation the plots soon begin to get dried. Then they are trampled well under feet so as to make speedy germination possible. The first weeding is done 15 days after the germination is noticed and planting in the gaps referred to above is also done at the same time. When the crop is about two months old a second weeding is given by those who can afford it. If there is no sufficient rain in time the plots have to be irrigated. Generally six irrigations are given. While the work of weeding and planting is in progress the seedlings are arranged so as to leave a space of 4″ between each other. It is usual to avoid the expenditure on this item by employing adepts in broadcasting who take care that the seeds generally fall from 3 to 6 inches apart.

Harvest.—The crop will be ready for harvest in about $3\frac{1}{2}$ or 4 months. Harvesting is done by female coolies who uproot the plants and stock them in heaps. Usually an irrigation is given (if there is no rainfall) a week before harvesting as the plot is to be slightly moist for easy harvesting. The uprooted plants with bulbs are washed so that all particles of earth adhering to the bulbs are removed. Then they are stripped off their roots, bundled together and stocked in ceilings of houses where they are allowed to dry in shade. After 15 or 20 days the bulbs are separated from the stalk and carted on to shandies for sale. The mungar crop generally yields from 50 to 60 maunds and the hingar crop from 40 to 45

maunds per acre. In case of good cultivation and heavy manuring the yield ranges between 75 and 100 maunds per acre. Usually 40 maunds are loaded in one cart.

The crop is also disposed off before harvesting through "Hasaravani" or "Pachmaru".

Pests and Diseases.—Hitherto the crop has not been subject to any kind of insect pest or disease. Sometimes, at the time of the north-east monsoon, the plants will present a withering or parched appearance and the leaves become pale white in colour. On examination it is found that the plants are lacking in chlorophyll matter and are assimilating the nourishment reserved in the bulbs. In such cases a poor out-turn is expected—about 8 to 10 mds. per acre. This poor yield is due to the shrinkage in the size of the bulbs. As this crop is extensively grown here the question of the relation of the cost of its production to its yield per acre is well worth investigation.

Cost of Cultivation calculated per acre.

	Rs.	A.	P.
Ploughings (four)	4	0	0
Halube (twice)	1	0	0
Cattle Manure (10 cart-loads)	10	0	0
Seed (8 maunds)	24	0	0
Preparation of bulbs—1 male and 1 female cooly ..	0	8	0
Opening drains	0	4	0
Broadcasting—2 men	0	10	0
Halube to cover seed	0	4	0
Treading after irrigation—10 female coolies ..	1	14	0
Interculturing	0	8	0
First weeding—30 female coolies	5	10	0
Second weeding—20 female coolies	3	12	0
6 irrigations	1	14	0
Harvesting—50 female coolies	9	6	0
Washing bulbs, stripping roots and bundling—10 female coolies	1	14	0
Bundling small bundles and loading—2 men ..	0	10	0
Transporting to the house	1	0	0
Tying the small bundles to hang in ceilings—4 female coolies	0	12	0
Removing stalks from bulbs—20 female coolies ..	3	12	0

Remarks:—Some remove the root and stalk after the stuff is completely dried up.

		Rs.	A.	P.
Carting to shandies	40 maunds per cart for Rs. 3 ..	4	8	0
Assessment		4	0	0
	TOTAL ..	80	2	0
Cost of producing hingar crop		66	2	0
	GRAND TOTAL ..	146	4	0

Mungar crop yield average ..	60 maunds
Hingar crop yield average ..	40 maunds
TOTAL ..	100 maunds

Cost of 100 maunds at Rs. 2-8-0 per maund ..	250	0	0
Deduct total expenditure incurred on it	146	4	0
NET PROFIT ..	103	12	0

Agricultural Co-operation and Co-operative Cotton Sale Work

BY

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Agricultural Inspector.

Agricultural co-operation is one of the effective means of popularising scientific methods of agriculture, particularly among the rural folk. This is well illustrated in the instance of the Maradihally Co-operative Society, Unlimited, Hiriyur Taluk. The village society is situated in the black cotton area, where the demand for superior variety of sanna hathi seed is great. The Department of Agriculture is distributing for some years past a select variety of sanna hathi, selection 69, which is much superior to the local sanna hathi. It gives a higher ginning percentage (sel. 69 cotton—28 per cent, local sanna hathi—25 per cent), has greater staple length, a brighter colour, a softer feel and therefore finds a more ready sale and a higher price than the local sanna hathi. At the instance of the Department of Agriculture the Society has taken up the work of distributing the sel. 69 cotton seeds purchased from the Department, among its grower-members at the time of sowing. The members can either purchase the required quantity of seed for cash or on credit for a year and pay the cost together with a reasonable rate of interest fixed by the society. They can

conveniently pay this out of the proceeds of the crop. On the recommendation of the Registrar of Co-operative Societies the Apex Bank finances the necessary cash credit loans to enable the Society to sell seeds on credit also. On account of such facilities afforded by the Society the whole cotton area of 2,000 acres of the Maradihally village has come to be sown with this improved variety this year.

The Society has also undertaken to supply pure sel. 69 cotton seeds required by the Department of Agriculture for distribution during sowing season. The quantity of pure sel. 69 cotton seeds available on the Government Experimental Farm, Hiriyur, is directly handed over to the Society every year for multiplication on selected areas of the village and the quantity so given is returned to the Department the following year. The Society in turn distributes the seeds to some select members on condition that the crops shall be raised in a pure form (unmixed with other varieties) and render proper care and the whole produce handed on only to the Society for sale. Similarly the Society distributes selection 69 cotton seeds raised from crops grown in the village itself from the Farm seeds to be sown over the remaining area of the village. The produce raised in this manner is distinguished from that raised directly from the Farm seeds stocked separately in the village.

Three years ago the Society undertook with the help of the Agricultural Department co-operative selling of the cotton produce. The scheme is being worked thus: The Apex Bank advances cash credit loans to its members at a reasonable rate of interest to an extent of not more than 60 per cent of the minimum estimate of their produce in order to enable them to pay their *kandayams* (Land Revenue), etc., on the clear understanding that all their sel. 69 cotton should be handed over in a pure form to the Society. The Society stocks the kappas separately according to quality and distributes the same under the supervision of the Agricultural Department. The seeds are well sieved and cleaned, and after meeting the requirements of the Department are sold away locally.

For all the trouble and care taken by the Society in supplying pure and clean sel. 69 cotton seeds it gets a premium of 10 per cent over the ruling price of the market. As regards the lint,

it is cleaned, pressed into bales and sold to large buyers at Chitaldrug. All the various operations incidental to this system of co-operative selling are managed by a committee previously formed for the purpose at a special General Meeting of the Society. The members so chosen are generally men of long experience in trade and personally attend to weighing, stocking, arranging sales and ginning cotton, etc., and each of them gets a portion of the bonus declared at the end of the work. Immediately on realization of the proceeds of the seeds and the lint the loan taken from the Apex Bank for this purpose is invariably returned. At the close of all transactions the net sale proceeds are distributed over the whole quantity of sel. 69 kappas collected from different members, setting apart a small amount for bonus and the rate settled as worked out by the value per maund.

By the adoption of this system the dangers attendant upon individual enterprise due to market fluctuations are minimised to the greatest possible extent, while the advantages of co-operative sale of lint and seed separately after ginning instead of selling cotton kappas are ensured. Apart from the benefit of higher ginning percentage given by sel. 69 cotton a premium ranging from Rs. 3 to Rs. 6 per candy of 500 lbs. of lint over the prevailing market rate can be got as also the 10 per cent premium for the seeds as stated already. Further the purity of the seeds and the lint is maintained throughout.

The following is a brief statement of the cotton sale work done by the Society :—

	1929-30	1930-31	1931-32
1. Quantity of sel. 69 cotton seeds distributed by the Maradihally Co-operative Society, Unlimited ..	Mds. 250	Mds. 350	Mds. 500
2. Cash credit loans advanced by the Apex Bank ..	Rs. 3,000	Rs. 5,000	Rs. 8,000
3. Total quantity of kappas collected by the Society from members ..	Mds. 2,154	Mds. 5,338	Mds. 9,643-21½ dhs.
4. Ginning percentage obtained of sel. 69 cotton ...	27.83	28.37	28.20
5. Quantity of lint sold by the Society in terms of bales of 400 lbs. each ..	40	99	184

	1929-30	1930-31	1931-32
6. The rate fetched by the Society per candy of 500 lbs. of lint ..	Rs. 135	Rs. 105	50 bales @ 118 30 bales @ 118 20 bales @ 114 84 bales @ 97
7. The rate prevailed locally on the date of selling by the Society ..	Rs. 129	Rs. 100	Rates prevailed at the Chitaldrug market at different times of selling by the Society; Rs. 115, Rs. 110 and Rs. 93.
8. The total volume of business ..	Rs. 5,832	Rs. 10,914	Rs. 21,487-13-4
9. *Remarks* :—Last year 78 members co-operated in the sale work, which was started by only a few members in the beginning. For its various successful activities the Society was awarded the Shield of Honour both last year and this year.			

Hearty co-operation combined with adequate competency is what is required in the successful working of societies of this kind for the common benefit of one and all. A good number of similar societies will contribute largely to the general prosperity of the country, particularly of the rural classes and will help in the spread of scientific methods of agriculture throughout the State.

Are Sprayed Grapes Poisonous ?

BY

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In the article on the Downy Mildew in Vol. XIII, No. 3, p. 109, of this Journal a reference was made to the safety in consuming sprayed grapes. For those who want more information on this point, the following notes are reproduced as gathered from literature available on the subject.

The question resolves itself into two parts, firstly are the copper salts retained by sprayed fruit injurious to health, and secondly are unsprayed and healthy fruits and foodstuffs devoid of copper ?

Although everybody would answer the first part of the question in the affirmative, it may be said that there is difference of opinion

even on this point. An adult can absorb daily for a period of several weeks without ill-effects, from 0.2 to 0.5 gram (1 gram equals 15.438 grains) of copper sulphate. Half a gram is usually considered the maximum amount that may be absorbed for any length of time without injury to health, although cases are on record where as high as 2, 3 and even 4 grams have been absorbed for a number of days in succession without any ill-effects whatever. But we have to remember that the copper in Bordeaux mixture is present in the form of an insoluble compound, and doses of copper four to five times greater can be administered in an insoluble than in a soluble state. If that is so a man can safely absorb the same quantity of an insoluble compound. Sprayed grapes on analyses, have rarely been found to contain more than 5 milligrams (0.005 gram) of copper per kilogram (1,000 grams or 2 1/5 lbs.), the average being from 2½ to 3 milligrams per kilogram. In other words, 1,000,000 lbs. of grapes sprayed in the usual way would contain from 2½ to 5 lbs. of copper, or 1,000 lbs. of fruit would contain 17.5 to 35 grains. On this basis an adult may eat from 300—500 lbs. of sprayed grapes per day without fear of ill-effects from the copper. But if we make allowance for the fact that the copper in Bordeaux mixture is insoluble, this quantity is easily raised to 1,200—2,500 lbs. per day. A man who can do such a feat and repeat it daily is yet to be born. Similarly, sprayed tea shows copper in the manufactured leaf. But a man who drinks tea prepared in the ordinary manner does not exceed the limit of safety if he keeps himself within ten thousand large cups a day. Not even the great Samuel Johnson who was very much addicted to tea, could have been poisoned if he had used sprayed tea.

Having analysed the first part of the question we might take up the second. Here we are on safer ground, for we find that even the articles of our daily food are not free from copper. Grapes which have never been sprayed may contain as much as 2 milligrams of copper per kilogram, wheat from 4 to 10 milligrams per kilogram, rice 1.6, bread 1.5 to 4.4, potatoes 1.8, beans 2 to 11, cocoa 12 to 29, tea 12, beef 56 to 58, sheep liver from 35 to 41, while in chocolate the enormous amount of 125 milligrams per kilogram has been found. It occurs in small quantities also in carrots, peaches, figs, tamarinds, black pepper, and many other fruits and

spices. Regreened canned vegetables contain from about two to sixty times as much of the metal as sprayed grapes. Regreening consists in dipping the vegetables for 8—10 minutes in a solution of copper sulphate in order to fix the natural green colour, and then after washing in water, placing them in jars containing a solution of common salt, sealing and sterilizing by heat.

These facts should easily disabuse anybody of any doubts he might have had as to the safety in consuming sprayed fruit.

A Note on the Scope of Simplifying Areca Curing Methods in the Malnad and Eliminating Waste Therein

BY

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The scope for useful work in connection with the existing methods of curing areca nuts in the Malnad lies mainly in the introduction of simple and fairly cheap methods of drying the boiled nuts in artificial driers and it is along this line that considerable work has been done by the Department with some gratifying results.

The existing methods entail practically every year and for every garden owner considerable loss and a great deal of trouble owing to the lack of facilities for drying the nuts properly by artificial heat. As is well known the Mysore Malnad areca has to be harvested at a particular stage of ripeness, *i.e.*, when it is about, say, three-quarter ripe or at the stage when the finger nail can without difficulty cut through the green husk into the kernel inside. If this stage is overstepped the quality seriously suffers, to the extent we may even say, of being reduced fully 50 per cent in the price of the cured product. As the inflorescences appear at various intervals one after the other during a period of some three to four months the bunches of nuts also come to this stage of ripeness one after the other at about the same interval of time except where one or more of the inflorescence drop off or fail to set. The harvest has to be of a selective character, conducted at different times of the year, at intervals of about a month or so. Thus the inflorescences begin to open from the middle

of November and finish about the middle of March and the harvest accordingly begins in September and finishes about the middle of January. The first harvest thus comes at a time when the monsoon rains have not stopped and the drying of the boiled nuts in the open therefore becomes impossible. When it is remembered that the boiled nuts have to be put out for seven bright sunny days to be considered sufficiently dry for marketing, it will be realized what a great handicap rainy weather proves to be. Even in localities with a later maturing crop the first harvest is not quite free from the risk of rain ; so that with the first harvest this trouble exists in all parts of the Malnad and with the first and second harvests in most parts. The way to get over the difficulty is either to put off the harvest or to resort to artificial drying. The first course leads to over-ripeness in the nuts and consequently an increase in the proportion "Bette" (too ripe) quality in the produce which greatly reduces the price. The diminution in value may be judged from the following prices for the two grades :—"Hasanu" Rs. 14, "Bette" (of three grades Yesalu, Dodda and Sanna) average Rs. 7. The grower therefore generally tries to avoid this course and resorts to a crude system of artificial drying. The method consists in spreading the nuts on specially made strong bamboo mats supported on four posts about 3½ to 4 feet high and to keep up a slow fire under the mats by burning large billets of wood till the nuts are dry. The fire is kept going day and night and is closely watched to see that it does not blaze up, pots of water being kept always handy with the men keeping watch. The smoke makes the drying shed very difficult to work in, and in the ordinary houses permeates the whole place. If it is not closely and constantly watched the mats and nuts may get charred if not burnt ; it is even reported that houses have been burnt down from this cause. Only those who have witnessed the process can realize how taxing a work it really is ; it is only the poor long-suffering Malnad ryot that can stand the strain. An ordinary charge by this method will require about 70 hours of continuous firing and drying, and give about a maund of 28 lbs. The quality of the nuts will be poor, being dark in colour and smelling strongly of wood smoke. The price as compared with proper sun-dried nuts of the same grade will be also lower being about 16 to 20 per cent less. As this price, low though it is, is vastly better than that of the "Bette" quality which will be the product obtained if

the artificial drying had not been adopted, this latter is resorted to in spite of its attendant difficulties. No careful areca grower can afford to be without provision for artificial drying ; the first two harvests will need it at some stage or other and even later ones when there should be untimely rains. Even if we leave these later harvests out of account the drying will be required for saving quite a good proportion of the year's out-turn, because these two may amount to as much as 30 per cent of the total.

On account therefore of the importance of the matter and of the unsatisfactory drying methods in vogue, the Department got out a special drying apparatus for the Marthur Farm for trial. It has been found quite serviceable but, from the garden owner's point of view, absolutely unsuitable on account of the cost. To meet this difficulty a local imitation of this apparatus was constructed ; it was found quite as good as (in fact somewhat better than) the imported one, although the latter was portable while the local one was a stationary structure. The performance of the improved drier, the local imitation and the "Hoge Thatti" or smoke drier is given below for comparison (Statement attached). As regards prices fetched the nuts dried in this drier fetched almost as much as was paid for sun-dried nuts in the Sagar market.

Having thus satisfied ourselves about the efficiency of this cheaper locally made drier the next step was to make it popular and induce areca growers to construct such driers for themselves. In addition to the usual descriptive leaflets, plans and sketches were distributed and card-board models were supplied free. Every year a short course was held on the Marthur Farm during the early part of the areca harvest when the two kinds of driers were in use on the Farm and visitors were given an opportunity of watching and studying them. To all such visitors copies of detailed plans of the drier and the cardboard models were supplied free. Help was also given in the actual building of the drier for those who put down such driers by sending out men trained in the work. More substantial help was also given to a limited extent by the supply of the iron materials at half cost, the other half being met out of a grant generously made for this purpose by the District Board of Shimoga. Progress has however been slow, chiefly because, this is an improvement which costs more money than the ordinary grower is disposed to spend. If all

materials have to be bought, a drier may cost about Rs. 90 to build and this is a fairly big sum for him.

A certain number of garden owners have nevertheless come forward and availed themselves of these facilities and have put up driers of their own. The number of such growers is as stated below :—

Nagar Taluk	4
Sagar Taluk	13
Sorab	2
Thirthahalli	6

Much work has to be done not only in popularizing this type of drier but in the devising of a larger and more convenient type. Last year I made a small beginning but had to give up for want of funds. Good driers are important not only in the areca nut area but also in the cardamom tract, and work in this direction will be appreciated in both these tracts. When one compares the large cardamom driers of the Cardamom Hills in the Madura District with the primitive arrangements in Saklespur or again the rapidity with which large flue-curing houses for tobacco drying are being put up round Whitefield near Bangalore, one feels that the poor Malnad ryot has not had any thing like his due share. However, as this is a matter which holds out promise of some material financial gain to the areca grower, adequate funds should be provided for conducting experimental and other work both in the Farm and in the private gardens.

Among simple labour-saving appliances for the curing shed is a small pulley hoist, for raising and lowering nuts on to and from the drying platform which is usually about 12 to 15 feet above ground ; at present men have to climb up and down ladders, and carrying a basketful of boiled areca nuts hot and dripping is neither easy nor quick. An ordinary pulley arrangement can make the work quick and more convenient. This has been explained to many growers and I think it will be taken up. If money is set apart for putting up a dozen or so at half cost to the growers, the arrangement will then be taken up by a large number.

Somewhat frequent representations from areca growers not only in the Malnad but in the Maidan also relate to (*a*) the devising of machinery to shell the nuts, which is now all done by hand in the old familiar way, (*b*) the utilization of the areca husk for some profitable purpose ; it all now goes into the manure pit or rots on the road

margins of villages. Now both these are very desirable lines of work indeed. The shelling with the familiar knife-boards (Eligemane) is very slow and requires a big force of labour at a time when this sort of labour is difficult to get for everybody. As however shelling and slicing of the nut either into two halves as for "Batlu adike" or more slices as for "Chooru adike" are both done by the coolies in one operation, it is not so wasteful as one may ordinarily suppose. Quick work will however be universally appreciated. It may be recalled that many attempts have been made for getting proper machinery for this work, both here and abroad: without going into details it may be said that nothing satisfactory has been found possible: it is however not impossible seeing that machines can do most wonderful things. The matter should receive further attention. Similarly too in the case of areca husks, its uses for bristle fibre, fibre for spinning into coarse gunny yarn and gunny weaving, filling for cushions, paper and fibreboard material and other matters have been talked about. Consignments have also, I believe, been sent to foreign countries now and again, but so far nothing tangible has resulted. On the Marthur Farm some experiments have been going on to make the husks rot quickly for manurial purposes as at present it is too lignified to decompose satisfactorily; it has also been used as mulching material with very good results and this may furnish some useful outlet for the husks, but these are only ways of dealing with it as refuse and not as a bye-product of value.

A request is occasionally received to show the ryot how to give the proper colour to the nuts; but this matter is generally well understood by the local men, especially in regard to the class of articles for which the Malnad markets enjoy a reputation and the request generally comes from novices. There seem to be some people at least who claim that they possess some special methods known only to themselves, and one such person demanded a fee of Rs. 700 when I asked him if he would go to Jagalur and teach the areca garden owners there, the Malnad methods of areca colouring. There may be something in it possibly, and the matter may find a place in any work started to study and improve methods of areca curing.

A bye-product of some importance which deserves to be investigated and which even at present has a money value is the "Chogaru", *i.e.*, the inspissated liquor in which the nuts have been

boiled. This material is valuable as a source of tannin as may be judged from the fact that raw arecanut contains from 20 to 30 per cent tannin and the boiling removes fully one-half of this quantity. At present it finds a market in Bombay for tanning, colouring and catchu making as far as I have heard and small quantities are sent out from our Malnad to Bombay. This matter should be looked into further for it will be a source of some additional income to the garden owner.

In conclusion, I would emphasize that the most important work that has been so far done to simplify areca curing work is in respect of the construction of areca driers and popularizing them among the garden owners, and that further work along the same lines deserves to be encouraged by the provision of adequate funds.

ARECA DRYING EXPERIMENTS.

S. No.	Variety of Areca	Name of Drier	Weight of nut taken	Time taken	Wt. after drying	Remarks
			lbs.	h. m.	lbs.	
I	(*a*) Sliced (Batlu adike)	Imported drier	90	42	28	Colour of nuts dark
	(*b*) Do.	Local drier	90	39	29	Fine colour
	(*c*) Do.	Hoge thatti	90	65	30	Smell of smoke
II	(*a*) Full nuts (Idi-adike)	Imported drier	100	69 50	30	..
	(*b*) Do.	Hoge thatti	100	77 30	35	Smell of smoke

Sugarcane Breeding Work in Mysore

BY

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The elevated plateau of Mysore is eminently suited for sugarcane breeding work on account of its altitude, distribution of rainfall in the two monsoons and the general climatic conditions. Most of the exotic canes flower annually in succession beginning from October and ending in January. They ripen and shed their seeds in January when the weather is cool and often foggy. Such a condition is very well suited for the germination of sugarcane seeds, and we have noticed cane seeds germinating in profusion in the cane field. Many canes which do not flower elsewhere seem to flower here. These facts were observed by the Indian Sugar Committee in 1919 and they went so far as to suggest the opening of a Breeding Station in Chittoor District since Bangalore was

situated in the Indian State of Mysore. Our experience during the last 18 years is that the Hebbal Farm is admirably situated for carrying on sugarcane breeding work. The elevation is 2950 ft. above sea-level and it has an annual rainfall of 30″ spread over nine months from August to January. The minimum temperature is 52°F. in December and the maximum temperature in April is 96°F. The air is dry and there are no high winds. The soil is sandy loam and well suited for cane growing.

Work on sugarcane breeding was started in Mysore early in 1912. We have been co-operating with Dr. C. A. Barber, Professor J. B. Knight and Rao Bahadur T. S. Venkataraman since then. Very early, in our work, we discovered that the exotic canes and even the standard indigenous canes were hybrids in their constitution and that they produced, in their turn, an innumerable number of variations. It was, therefore, in order to increase the number of chances of securing good ones, that several lakhs of seedlings were raised every year from different parentage. The seedlings originally selected for their great vigour and other agricultural qualities were carefully tested for the quality of their juice and only those showing a high sucrose content were retained. Some parents like Red Mauritius were found to produce vigorous seedlings and others like Barbados 208 to produce rich seedlings but very poor in vigour. It was only by a thorough chemical control in the work from the very beginning that we have been able to isolate vigorous canes, rich in sucrose and having a low quantity of glucose. Our main object all along has been to produce canes for high tonnage and for producing good hard jaggery with keeping qualities.

At present, we have in the specimen plots 30 indigenous and 54 exotic sugarcane varieties under observation. Some of them produce more rich seedlings than others. The following figures give a few examples of the character of some parents :—

	Percentage of seedlings having total Solids in their Juice.	
	More than 15 %	Less than 15%
Barbados	27.3	72.7
Striped Mauritius	17.5	82.5
White Mauritius	30.0	70.0
Ashy Mauritius	18.6	81.4
Java Mysore	9.5	90.5
Cheni	70.0	30.0

Red Mauritius, Java canes in general, Demarara canes and many others have given vigorous seedlings ; but a very small number of them

have produced seedlings rich in sugar. On the other hand, there have been among the seedlings of all Barbados canes, many rich canes but they all lack in vigour. In a few years, we were able to discard many canes as bad parents in breeding work. It is generally considered that thick rich canes or noble canes have not much vigour and therefore attempts are being made to cross them with wild saccharums like *S. spontaneum* to introduce vigour into the noble canes. Our experience has been that all the noble canes are hybrids and they, on selfing, produce seedlings of various kinds among which, many are thin or reed canes of which some are rich in sugar and others poor. Often, these thin canes are hard and useless but on rare occasions, we have secured vigorous rich canes. We are inclined to believe that in many cases some inhibiting factors have been suppressing vigour and other characters in noble canes. One of them, Local Striped 0-0-3-8, a seedling raised from local pattapatti, is very vigorous and fairly rich in sugar. A small plot on the Hebbal Farm recently harvested gave a yield of over 65 tons when the canes were only seven months old. Such thin, rich and vigorous seedlings have been now raised out of H.M. 89, Red Mauritius and Striped Mauritius. Heterozygous thick canes have been crossed with the thin wild forms of saccharums by many to get vigorous seedlings. It has been observed that the thin character is recessive in most of the canes, and it is rather doubtful to say whether the thin seedlings raised from the crossed arrows are the results of the crosses made or only the segregates rising out of the heterogeneous parent. This problem becomes more complex when a number of hybrids are used for crossing one with another in succeeding generations. The pollen and the ovaries are so heterozygous that it is difficult to make out in what manner the combinations have taken place in the resulting hybrids. In these complex crosses, there is every chance of the vigour of the wild forms not being included at all. This rather crude kind of breeding work was considered sufficient as long as one believed in the blending of characters, but now that the purity of gametes has been recognized, work in future has to be based on a more scientific basis. We have, therefore, utilized all the sugarcanes as parents and made our selections out of several lakhs of seedlings. From among the seedlings raised by selfing flowers, we are trying to raise homozygous canes. There is every likelihood of these seedlings being less complex than their parents. We have further noticed that while thick canes have produced thick and thin seedlings, thin canes have so far not produced any thick canes. By selfing a few generations of selected seedlings, we hope to establish pure homozygous canes rich in sugar both in the thick and thin canes. From such a foundation stock, we propose

to build up new seedling varieties. It will be many years before the hybrid nature of standard canes is fully exploited.

In 1914, two thousand selected seedlings were planted, out of which 300 were promising. Twenty of them contained more than 20 per cent sucrose, one of them giving as much as 22 per cent sucrose in the juice. By 1917, as many as 58 promising ones were under observation. It was in this year that H.M. 320 and H.M. 544 were evolved. Even in the early stages, some of them indicated their capacity for very high yields. Promising ones were tested in different places as early as in 1917. In 1918, a thorough weeding of doubtful performers was made for making place for fresh seedlings. By 1923, promising seedlings had been tested in several localities in the State, in places having nearly 300 inches of rainfall and in the dry and saline tracts. H. M. 544 became popular in the eastern part of the State where the soils are sandy and had an early season. In rainy zones and on heavy soils, these canes take a longer time to mature than the usual period of one year. It was found early that no one cane suited all the parts of the State and that a number of them were required for different places having different sets of conditions for making a successful growth. From 1923 to 1929, more attention was paid for testing canes in the districts and distributing the best ones fit for each locality. By 1930, the following canes had become established in Mysore :—

1. H.M. 544 has become popular in the eastern districts and in parts of Malnad. This is quite unsuited for poor soils or gravelly soils. This will not ripen on heavy soils early. It is a very thick yellow cane.

2. H.M. 320 is a medium cane and is as rich and early as the local Pattapatti. It tillers freely and produces the greatest quantity of good hard jaggery. Yields of 60 tons have been harvested. It is now displacing all other canes in most of the eastern districts of Mysore.

3. H.M. 553 is becoming popular in the Malnad and semi-Malnad and in Chitaldrug District.

4. H.M. 602 is a thin cane and is well suited for alkaline soils in the dry parts of the State.

5. Babbur striped, a bud-variation from H.M. 544, is very vigorous and is replacing H.M. 544 in many places ; but it is slightly poorer in sugar than H.M. 544 and takes slightly longer time to ripen.

Many promising seedling canes are under observation on the Hebbal Farm for several years. The quality of juice at various stages of growth of some of the promising seedling canes are as follows. The canes were planted in January 1931 and tested from August to Feb. 1932.

Study of Sugarcane Varieties at different stages of growth—Hebbal Farm, 1932.

	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
H.M. 500							
Internodes ..	15	19	21	24	28	29	
Weight of 1 cane ..	lb. oz. 2 15	lb. oz. 3 9	lb. oz. 3 13	lb. oz. 3 8	lb. oz. 4 0	lb. oz. 3 11	
Per cent of Juice ..	..	..	..	..	..	..	
Brix ..	14·16	17·27	17·90	18·85	16·43	19·51	20·85
Sucrose ..	10·1	14·30	15·50	16·60	14·0	18·1	20·0
Glucose ..	3·13	2·27	1·47	0·96	1·47	0·625	0·20
Purity ..	70	82	82	88	85	90	96
H.M. 320							
Internodes ..	14	16	21	27	24	27	
Weight of 1 cane ..	lb. oz. 3 3	lb. oz. 3 6	lb. oz. 4 2	lb. oz. 5 6	lb. oz. 4 8	lb. oz. 5 0	
Per cent of Juice ..	..	..	..	..	..	..	
Brix ..	13·83	17·67	17·98	18·59	18·04	18·98	20·78
Sucrose ..	9·2	14·20	16·40	16·7	16·05	17·80	19·7
Glucose ..	4·17	2·27	1·00	1·04	1·04	0·62	0·57
Purity ..	67	80	91	89	89	94	95
H.M. 544							
Internodes ..	10	13	19	23	21	22	
Weight of 1 cane ..	lb. oz. 2 13	lb. oz. 3 9	lb. oz. 4 10	lb. oz. 6 0	lb. oz. 5 3	lb. oz. 4 12	
Per cent of Juice ..	..	..	..	..	..	..	
Brix ..	12·21	13·02	15·03	16·36	16·29	17·51	18·71
Sucrose ..	6·95	8·20	11·70	13·65	13·45	15·5	17·00
Glucose ..	5·0	3·60	2·50	2·08	1·92	1·38	0·78
Purity ..	57	63	78	83	83	89	91
H.M. 544 (Striped)							
Internodes ..	11	14	20	22	21	23	
Weight of 1 cane ..	lb. oz. 2 15	lb. oz. 3 14	lb. oz. 5 8	lb. oz. 6 0	lb. oz. 5 10	lb. oz. 5 13	
Per cent of Juice ..	..	..	..	..	..	..	
Brix ..	12·14	14·07	15·38	16·85	17·6	18·44	18·58
Sucrose ..	7·25	9·2	12·40	14·05	15·3	16·7	17·0
Glucose ..	4·17	3·60	2·08	1·78	1·32	0·96	1·04
Purity ..	60	65	81	83	86	91	91
Local Striped							
Internodes ..	11	15	18	25	25	26	
Weight of 1 cane ..	lb. oz. 2 0	lb. oz. 2 2	lb. oz. 2 13	lb. oz. 3 6	lb. oz. 3 6	lb. oz. 3 3	
Per cent of Juice ..	..	..	..	..	..	..	
Brix ..	13·29	16·38	17·50	18·50	16·96	16·57	19·18
Sucrose ..	8·0	12·65	15·40	16·75	14·55	14·5	18·00
Glucose ..	3·13	2·80	1·39	0·78	1·39	1·19	0·63
Purity ..	60	77	88	91	86	88	94

In seven months after planting all the Java seedlings including E.K. 28 and P.O.J. 2878 and almost all the Coimbatore seedlings begin to flower, stop further growth and there is no possibility of their producing heavy yields. On the other hand, our more recent seedlings H.M. 603, H.M. 607 and H.M. 606 are producing heavy yields. The North Indian canes usually make a tardy growth. Coimbatore seedlings are giants by their side and they, in their turn, look like dwarfs by the side of our rich thin canes. It is quite possible that some of our thin canes are also suited to other parts of India. Dr. Posthumus of Java who visited the Hebbal Farm was disappointed to see the performance of P.O.J. 2878.

It was indicated by the "Indian Sugar Commission" in their report that new canes should be evolved to make the best use of good cultivation and manuring. We have not lost sight of that suggestion in our work. Manurial experiments on the Hebbal Farm have clearly shown that to get heavy yields, the seedlings require adequate manuring. The following table gives the results of trials in 1921 :—

	Cake alone.	Cake and Am_2SO_4.
H.M. 14	26.8 tons	32.7 tons.
H.M. 544	38.2 ,,	47.5 ,,
H.M. 312	40.8 ,,	54.7 ,,
H.M. 310	23.2 ,,	33.6 ,,

Since then various experiments have been conducted and at present we are giving as much as 6 cwts. of ammonium sulphate, and 2 cwts. of super per acre along with one ton of groundnut cake. In some cases we have harvested over 70 tons of cane per acre with H.M. 320 cane. On the back plots on the Irwin Canal Farm, crops of 53 tons per acre have been harvested.

It was believed that the jaggery from seedling canes would not be quite as good as that from our rich Pattapatti cane. Experiments conducted on the estates of Mr. Ooragahalli Krishna Iyengar in 1920 showed the following facts. The canes were grown and the jaggery was made by Mr. Ooragahalli Krishna Iyengar.

Analysis of Jaggery.

Cane.	Total Solids.	Sucrose.	Glucose.
Local Pattapatti ..	89.39	72.5	11.37
H.M. 544 ..	89.35	72.0	11.37
H.M. 310 ..	88.90	76.0	6.75
H.M. 14 ..	90.35	71.0	10.87

At present, jaggery made from H.M. 320 and H.M. 500 is quite as good as any jaggery made in the State. H.M. 602 is producing high class jaggery in the alkaline tracts. We are now trying to produce canes for

much higher yields and also rich, vigorous early maturing canes. Our future success lies in giving the raiyat the right sort of cane for his land in his locality and enabling him to reap the maximum profit out of his labours.

The future problem is not entirely one of producing a thick cane or a thin cane but one of producing canes which would increase the profits of the raiyat. Thin canes usually tiller freely. If the canes are thick their number per acre will decrease. If the canes are tall or heavy, then also the number falls down. We should try to get canes which would ripen early enough not to upset the rotations which suit a locality and at the same time, attempt to produce heavy tonnage.

The whole work on sugarcane breeding has been carried on by the staff in the Department whose major work is breeding work on ragi and other staple crops. There is no staff at present specially set apart for sugarcane work. Scientific knowledge during these 23 years has greatly advanced and we have gained in the field and in the laboratory much experience. A definite programme of work for sugarcane breeding has been already drawn up by the Department. With the help of the subvention received from the Imperial Research Council and the extra facilities given by the Government, breeding work on sugarcane has been greatly extended.

Cytological investigations which have been already taken on hand will be continued; for the present knowledge is quite obscure and the results so far obtained by various investigators are quite conflicting.

Improvement of sugarcanes by selections among bud variations has been vigorously pursued. We had some interesting results in this line of work. The local Rasthali has given a green and yellow striped cane. Pundia of Poona has also produced a similar cane and it was sent over to us from Poona by Prof. J. B. Knight. H.M. 89 and H.M. 165 have given red and yellow striped canes. Red Mauritius has produced a black and red striped cane. P.O.J. 33*a* has produced a red and yellow striped cane which in turn has given vigorous white canes like H.M. 602. H.M. 544 has produced the vigorous Babbur striped cane. Similarly, striped canes have been secured from H.M. 320, H.M. 500 and other seedlings which are now under observation. It has not been possible to get a striped cane from the seedlings even from among seedlings raised from striped canes. Probably, on account of the dominance of the colours one over the other, single colours or shades of colours only are exhibited in the hybrids. Whereas, in the bud variations, two colours segregate to form bands. However, this phenomenon not only gives an indication as to the

origin of banded canes but also indicates that in various other characters also there may be a good deal of variations which might be utilized in breeding work. Such cases have been already noticed. The green bud variations are always richer in sugar than the red ones.

Recently, X-Ray has become a powerful factor in plant breeding to induce variations by bringing about changes in the constitution of Gametes or Zygotes. Much work has been done on cereals in Europe and America. In Java, they are using X-Rays to bring about variations in Tobacco. In his visit to Java, Dr. Coleman saw some interesting results already obtained in their work. In America, they are using X-Ray for bringing about bud variations in fruit trees. As many of the canes do not flower at all or the periodicity of flowering does not coincide and the chances of getting the required kind of variations in seedlings are a matter of chance, using X-Ray to produce bud variations at will may be a powerful factor in the hands of the plant breeder. Since Hebbal Farm has been fully equipped with electric energy, the apparatus recently obtained will be set up there. So far as my information goes, X-Ray has not been used by any breeder in sugarcane breeding and it has not been used in any class of breeding work in India when this work was started in 1930.

Mysore plateau is ideally situated for sugarcane breeding work and producing any class of cane. There are already many thick canes and a few thin canes which are worthy of trial in other parts of India. Information gathered by the Sugar Commission goes to show that there are several hundred thousand acres fit for thick canes in Upper India distributed in various provinces from Peshawar to Assam. The results so far obtained and the success of Mysore seedlings elsewhere make us hope that we can help the cane cultivator in Mysore in particular, and India in general, to reap bigger harvests and help to stabilise the Sugar Industry. Over 3000 acres of H.M. 320 cane round about Mandya in the Irwin Canal tract have partially fulfilled our hopes and the requirements of the Mysore sugar factory at Mandya have created a greater demand for better and more vigorous canes. The performance of the new seedlings we have raised give us hopes for the future.

SELECTIONS

Top Working Old Coffee Trees

In an experiment recorded in the *Philippine Agriculturist*, Vol. XXI, 1932, 137 low-yielding *Coffee robusta* trees were cut back to from 60–90 cm. above the ground. Of the shoots which subsequently grew from these stumps (in 18–40 days) three or four were allowed to remain and were cleft grafted when fit (in about 250 days). The scions used were taken only from main stems and were : (*a*) young and green, or (*b*) older with woody stems. The covering material used was either glass tube (30.8 per cent success), spagnum moss (8.4 per cent success), or banana-leaf petiole (4.8 per cent success), the two last being moistened or changed respectively when necessary. Grafts with no covering beyond grafting tape gave 21.8 per cent success. The old woody scions gave 37.8 per cent success, the young green scions 14.1 per cent. The size of stock or of scion did not appear to have any direct relation to the success of the grafting. (*Horticultural Abstracts*, Vol. III, No. 1).—*Tropical Agriculture*, Vol. X, No. 6.

South-West Monsoon in India

From November to April the prevailing winds over India blow from the north-east, but during April the direction is reversed and from May to October the winds blow mainly from west in the Arabian Sea and from south in the Bay of Bengal. Among sailors these alternating winds are known as the north-east and south-west monsoons, from an Arabic word meaning seasons. In India, however, the ' monsoon ' means rather the annual rains which fall during the period of the south-westerly winds. The latter begin in May, but in this month the amount of moisture in the air is only sufficient to cause scattered thunderstorms. The real monsoon rains begin in June, when powerful streams of air sweep across India from the west on the west coast of the Deccan and from the south in Bengal. Each of these currents has a well-marked ' front ', which brings the first heavy rains, usually with thunder. The arrival of this front is the ' burst ' of the monsoon, which is often heralded by a weak cyclonic depression in the Arabian Sea or Bay of Bengal. The burst of the monsoon occurs early in June on the west coast and on or about June 15 in Bengal ; normally by the end of June the monsoon is established over the whole of India.—*Nature*, Vol. 131, No. 3318.

A Few Hints on Sharpening a Steel Ploughshare

Build a fire on the forge suitable for this particular work. This is done by banking the fire, allowing only a small opening in the side for the blaze and heat to escape. Commence with the point of the share. Insert this into the fire just far enough to heat the part you wish to draw, never permitting the heat to extend farther back on the share than is absolutely necessary. Draw this down to the proper shape and thickness, which should be as near the original level as possible. After the point has been finished, work back toward the heel or wing of the share, never heating more than $1\frac{1}{2}$ inches from the edge and $2\frac{1}{2}$ inches wide. It is important to keep hammering after the steel has changed from a red to a black heat, as this makes the edge tough and hard, giving a wearing surface that will last much longer. If once down the share is not sufficient, re-heat; but confine the heated part to the foregoing measurements. In working along the cutting edge, keep it straight. In so doing you will avoid having to go back and reset the edge.

After a *solid steel share* has been set as instructed, it should be re-heated to a cherry-red and left to cool in the air; *it should never be submerged in water or oil.—Agricultural Gazette of New South Wales*, Vol. XLIV, Part 10.

Russian Method of Artificial Insemination

The article describes the methods adopted in Russia for artificial insemination of sheep. In Russia, a country of great distances, the economic programme calling for rapid improvement of existing livestock made it imperative to use the expensive pure-bred sires which had been imported from foreign countries to the greatest possible extent in grading up local herds. This naturally gave new impetus to attempt at perfecting the methods of artificial insemination. It seems probable that artificial insemination will play an important role in the future of livestock breeding in general, since it will enable breeders to make much more rapid progress towards reaching the goal of their breeding programme. Although the methods described have been specially worked out for sheep, very similar ones are used in Russia for house cattle and pigs. During 1931 in Russia one of the methods was used for the insemination of several hundred thousand sheep and of about 187,000 cows; it has also been used for horses and donkeys. Essentially all the methods consist in collecting the sperm from the vagina of the animal after it had been served and injecting the same into the vaginas of other animals. During 1930, it was found that the sperm of a single can when fully utilised was

sufficient to inseminate from 300 to 400 ewes during one season. One service of the ram on the average gave enough sperm to inseminate six ewes. About 90 per cent of all ewes inseminated, became pregnant which is as high as can be expected under normal breeding conditions. As many as 400 cows can be inseminated from a single service of a bull, and as many as 1,250 cows have been actually inseminated from one bull in the course of a year. Ordinarily the possibilities of utilising the sperm will be limited by the available number of animals which are in heat. Experiments have been made, however, concerning the possibility of keeping the sperm. With a special glucose phosphate dilution fluid, and at a temperature of from 10 to 15° C it was found that raw sperm could be stored for 18 days and still be used for successful insemination. Studies are also being made in Russia concerning the possibility of inducing heat periods experimentally.—*The Madras Agricultural Journal*, Vol. XXI, No. 8.

Conservation of Farmyard Manure at Lyallpur

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The local method of dumping farmyard manure in a loose open heap was compared with the "Urine-earth" method at Lyallpur, a place with a low rainfall. Two pairs of bullocks of approximate equal age and weight were selected. The dung produced by one pair was collected and stored in an open heap according to the local practice. In the case of the other pair the urine was absorbed in a layer of canal silt and earth about 6 in. deep, spread on the floor of the bullock stand and kept loose by digging as required; the dung was removed and put in a *Kachcha* pit covered by a thatch and was pressed and covered with a layer of earth about 3 in. thick once a week. The bullocks under experiment were given similar treatment with regard to work and food. On an average they received about 44 lbs. of green fodder, 10 lbs. of *bhusa* and 2 lbs. of concentrates per head per day. Concentrates included gram (*Cicer arietinum*), barley (*Hordium vulgare*), wheat-bran, *toria* cake (*Brassica napus*, var. *dichotama*), and American cotton-seed (*Gossypium hirsutum*). From December to May green fodder consisted of *sarson* (*Brassica campestris*, var. *sarson*), *raya* (*Brassica juncea*), French oats (*Avena sativa*),

berseem (*Trifolium alexandrinum*), shaftal (*Trifolium resupenatum*) and *senji* (*Melilotus parvijlora*) and from June to July of maize (*Zea Mays*), *guara* (*Cyamopsis psoralioides*), *swank* (*Panicum colonum*) and Sudan grass (*Andopogon Sorghum*, var. *Sudanensis*) as available. After every four weeks, the pairs were made to change places so that individual differences with regard to quantities of roughages consumed and dung produced might be eliminated as far as possible. Thus approximately half of the dung of such pair went to the open heap and the other half to the covered pit. The experiment was started on 2nd December 1929, and was concluded on 19th July 1930, covering a period of 230 days. The total rainfall during this period was 3.87 in., the number of rainy days being 35 ; the heaviest fall was 1.8 in., on the 4th July 1930.

At the end of the experiment the urine-earth and manure from the open heap and covered pit were weighed and sampled for chemical analysis. The quantity of manure produced by the different methods under investigation and its nitrogen content is given in the following table :—

	Local Method.	Improved Method.	
		Solid manure from covered *Kachcha* pit.	Urine-earth.
	Lbs.	Lbs.	Lbs.
Total quantity	6,091.2	12,056.9	8,290.3
Total Organic Matter	2,520.4	2,103.2	..
Moisture percentage	35.05	68.30	7.9
Percentage of Nitrogen in the original sample containing moisture	0.2400	0.1563	0.1449
Percentage of Nitrogen calculated on the basis of dry matter ..	0.3695	0.5273	0.1563
Total quantity of Nitrogen present ..	14.62	18.84	12.01

The total quantity of nitrogen present in the manure has been doubled by the improved method.

The extra labour required to handle manure by the improved method is given below :—

	Man-hours.	Bullock-hours.
1. Cartage of earth from and to the field and digging the floor when required	88	16
2. Compacting dung in the pit, sprinkling water and covering it with earth	48	..
3. Carting extra water and added earth to the field in case of pitted manure	8	4

—*Agriculture and Live-stock in India*, Vol. III, Part IV.

Planting Young Fruit Trees

Of the commoner operations connected with fruit growing, none are more important than the planting of the young trees in their permanent positions, and in this comparatively simple operation, mistakes are often made which lead to failure and disappointment later on. Many people would be highly indignant if they were told that they did not know how to plant a fruit tree, and yet it is a common sight to see trees planted with their bud unions below the surface, or with soil heaped up round the trunk to such an extent that an ideal medium is furnished for the attack of the various root diseases.

The distance at which trees are planted has an important effect upon their subsequent development, and beginners, especially, should beware of the all-prevalent tendency in Cyprus to plant young trees too closely together. All orchard operations, cultivation, manuring, irrigation and, if necessary, control measures against diseases and pests, are more easily carried out if the trees are set at the proper distance apart and it is far better to err on the side of planting too widely apart, than to set the trees so closely that after a few years, spraying and similar operations are difficult, if not impossible.

The average planting distances employed in countries experienced in the production of high quality fruits are as follows, in respect of the types of fruit produced in this Colony :—

Apples	18 to 20 feet.
Peaches	,,
Pears	,,
Plums	,,
Apricots	,,
Citrus (oranges, lemons, grape-fruit, limes, mandarins)	,,

Cherries	25 feet.
Figs	25 ,,
Olives	25 ,,
Walnuts	40 ,,
Almonds	20 to 25 feet.
Banana	14 feet.
Pomegranate	12 ,,

The foregoing list is not represented as giving without question the correct planting distance for each type of fruit in this Colony: conditions may warrant some modification of the distances suggested. At the same time, it is certain that the majority of trees here are too closely planted, and the above figures are intended to give a good general indication upon which planting distances in this island may be based.

When the planting site has been cleared and preliminary levelling given, the soil should be ploughed and cross-ploughed, and, if possible harrowed, until a fine state of tilth is reached. Levelling is especially important where irrigated fruits are to be grown, in order to get a thorough and even distribution of water. When this has been accomplished it is advisable to lay out the site for water channels, make furrows and give a trial irrigation. In this way, any irregularities in the surface that were not apparent after the first levelling can be adjusted before the young trees are finally planted.

Unless it is financially urgent that the orchard be planted as quickly as possible, it is a very good plan to grow an annual crop, preferably leguminous, the year before planting the trees.

In all areas where prevailing winds are strong enough to interfere with the normal growth of the young trees, windbreaks should be planted. *Cupressus macrocarpa* is a useful species for the purpose in Cyprus, but a distance of from 40 to 60 feet should preferably be left between the windbreak and the first row of fruit trees.

In planting the fruit trees, the holes should be made about 1½ feet deep by 2 feet wide, and the soil from the holes should be placed in two heaps ("top" and "bottom" soils).

The "top" soils should be placed immediately round the roots when the holes are filled in. Manure should not be placed in the holes, but should be forked into the basin round the young tree after planting, and if the soil contains a large percentage lime about ¼lb. sulphate of ammonia should also be worked into the basin, to give the tree a good start, for all fruit trees prefer an acid rather than an alkaline soil. The

young trees should on no account be planted too low. This is a common and bad fault. It is almost impossible to plant too high and it should be remembered that the tree will settle from 2 to 6 inches after planting, according to the nature of the soil.

Trees should be set firmly, but the soil should not be rammed down to such an extent that water-logging and lack of æration result.

Unless there have been good rains at the time of planting, irrigation should commence as soon as the first two or three trees have been set; the second irrigation should be given two or three days later and an irrigation should be given thereafter every 7 to 10 days until the young trees are well established.

It is important to see that all trees are supported by good strong stakes (not canes) and the trunks should be whitewashed before summer, as a precaution against sunburn.

The newly-planted trees should be inspected frequently from the time the new shoots begin to grow, and all young growths not required for the building up of the framework of the young trees should be rubbed off.—*The Cyprus Agricultural Journal*, Vol. XXVIII, Part I.

Indian Central Cotton Committee

PRESS COMMUNIQUE

The Publicity Officer, Indian Central Cotton Committee, writes:—

A record of steady improvement in cotton industry, assisting largely in the betterment of economic conditions in India is described by the recently published annual report of the Indian Central Cotton Committee. A summary of the report may be conveniently divided under four heads:

(1) Legislation for the better growing and marketing of cotton;
(2) Statistics of value to the trade;
(3) Research—agricultural and technological to enable the Committee to offer produce of higher economical value to growers and manufacturers; and
(4) Broadcasting of information of value to create public interest in India's greatest industry.

Legislation and Marketing.

(*a*) The Committee's pamphlet "Cotton Improvement in India" which was circulated to all trade associations and many individuals interested in cotton, elicited much interesting and helpful comment. Tentative conclusions were arrived at, two important questions raised

being (i) India is capable of growing its present mill requirements of long staple cotton, but will it pay the grower in every case ? (ii) If staple cotton replaces the short-staple varieties at present grown, what effect will that have on the price of the two commodities ? These problems are on the anvil of the Committee and receiving their serious attention.

(*b*) The preliminary work in collaboration with the Imperial Council of Agricultural Research, in connection with the proposed investigation into the cost of cultivation of cotton and its rotation crops was completed and the full scheme was placed before the Committee for approval.

(*c*) At the request of the Tariff Board the Committee dealt with certain specific points in connection with the textile industry in India, perhaps the most important point being the examination of the proposition that the grower of long staple cotton in India was not realizing adequate price for his produce.

(*d*) The working of the Cotton-Transport Act was carefully watched. The only area where an amendment of the Act was called for was Indore, where it was restricted to only *Deshi Mewadi* cotton following a representation from the local mills.

(*e*) The Cotton Ginning and Pressing Factories Act worked smoothly and the few cases of infringement were reported to the authorities concerned. The views of various trade bodies were received regarding the necessity of licensing the ginning and pressing factories. No case of malpractice was reported during the year.

(*f*) The year under report witnessed still further progress in the steps taken to open regulated cotton markets in India. The question of the adoption of universal cotton standards for Indian cottons came up for discussion and the Committee decided to ascertain the views of commercial bodies and agricultural associations.

(*g*) The recommendations of the Special Sub-Committee which some time ago dealt with the reports on the investigations into the finance and marketing of the cotton crop were forwarded to the local governments concerned, an important move in this connection being the passing of the Bill for the standardization of weights and measures in Bombay.

(*h*) The Committee also drew the attention of the Governments of Bombay, Central Provinces, and Ajmere-Merwara to the high rates charged by "pools" for ginning and pressing, and requested them to take any action they thought necessary to prevent the grower being thus penalised.

(*i*) On the recommendations of the Committee the Madras Government lightened some of the penalties in the Madras Cotton Control Bill

(*j*) The fumigation of American cotton with a view to prevent the introduction into India of the Mexican boll-weevil, the most serious of all the cotton pests, was successfully carried out.

STATISTICS.

(*a*) An arrangement that is highly appreciated by the trade is that by which the forecast figures are posted by the Committee at the East India Cotton Association Office in Bombay, simultaneously with their release by the Director-General of Commercial Intelligence and Statistics in Calcutta. It has been the earnest desire of the Committee to reach as correct an estimate of the crop as possible and a reasoned memorandum on this subject is under consideration.

(*b*) The Committee has recommended to the Government of India that separate statistics for all loose cotton, exported or imported, should be made available for all such trade blocks as in the opinion of the provincial authorities responsible for the compilation of forecasts are of importance for this purpose, so that authorities concerned will be in a better position to estimate the accurate yield of cotton.

(*c*) On the recommendation of the Committee the Government of India separated Kathiawar from the Gujerat trade block in the classification of trade blocks adopted for the purpose of raw cotton trade statistics.

(*d*) The weekly circulars giving the purchases for Indian mills of American cotton, the arrivals and the quantity at sea, were issued regularly.

(*e*) In response to the Committee's request, millowners and exporters furnished confidential information regarding the export and mill demand of all types of Indian cottons. This will greatly aid the Committee in its programme of work and research policy.

RESEARCH.

(*a*) There were 29 research and other schemes under operation during the year under review, at a cost of Rs. 4,93,840. These schemes are classified into botanical—for the purpose of obtaining improved strains of cotton by selection and hybridization ; physiological—for investigation into the causes of shedding of buds, flowers and bolls ; entomological—for the study of the life and habits of certain pests and methods of combating them ; and mycological—for finding ways of overcoming the loss by wilt, etc. The more important of the schemes are in Surat, Dharwar, Khandesh, Nagpur, Coimbatore, Broach, Sakrand (Sind), Lyallpur, Parbhani (Hyderabad State), Baroda and Bikaner.

(*b*) An important activity of the Committee is the extension of improved varieties of cotton which have been evolved by the provincial Agricultural Departments and to bring to the notice of growers the results of the Committee's schemes which have proved successful. This phase of the Committee's achievements is of considerable value and increases in usefulness as the schemes now in progress bear fruit. Every facility is afforded to responsible organizations to popularise these seeds. These schemes are centred in Coimbatore, Hubli, Gadag, Surat, Khandesh, Athani, and operate also in Sind, Central Provinces and Hyderabad State. A ginnery has been erected at Lyallpur to deal with the large number of cottons from the experimental plots there, and to ensure proper supervision of ginning operations.

(*c*) The Technological Laboratory at Matunga, Bombay, maintained the high level reached in the previous year. Promising strains of new cottons which are being evolved at the different agricultural research stations were regularly tested. The results of the tests of standard Indian cottons were published in "Technological Reports on Standard Indian Cottons, 1932". Trade samples sent by the East India Cotton Association representing the average commercial crop of the year as well as samples supplied through the Millowners' Associations of Bombay and Ahmedabad were tested and the results were published in two-page technological circulars. The results of the tests when available for a number of years will afford useful and reliable information as regards improvement or deterioration of the varieties tested. In addition, cottons sent by individual firms were tested on payment of nominal fees. The special tests were continued on Banilla cotton and the results are embodied in a published report. Tests were also carried out to determine the effects of green stain on Sind-American cotton, the extent of harm done to good quality cottons by adulterating them with inferior types, irrigation tests and the normal moisture content of bales pressed under known conditions of temperature and humidity.

(*d*) The Institute of Plant Industry at Indore has been successfully carrying out its work as the centre of cotton research for the black cotton soil tract of Central India. Considerable progress has been made in the direction of agronomy, and the cumulative effect of grading, surface drainage, clean cultivation and application of cheap compost has trebled the yield of cotton on the Institute Farm. Attempts are now being made to carry these improvements to the contributing States. Selection work has reached the stage of comparative trial and it is hoped that Malwa will have an improved strain of cotton within the next two or

three years. The botanical survey of cottons grown in India was continued, and root systems, and X-ray exposures of seed, buds and pollen with a view to induce mutations, were studied.

Propaganda.

A new feature in the Committee's activities was the launching of a campaign of propaganda on behalf of Indian cotton on an extensive scale. By every means of publicity available—Press, poster, pamphlet, and exhibit—it is the desire of the Committee to bring before the public the improvements effected in Indian cotton, to encourage growers to adopt improved types of seeds and methods of agriculture, and to exhort manufacturers to give preference to Indian cotton.

Conclusion.

The excellent work done during the year in legislation, statistics, research and propaganda was continued during the subsequent months and it is evident that all interested in the industry—in India as well as abroad—have highly appreciated the efforts of the Committee in successfully tackling the problems for the benefit of the country.

Copies of the Annual Report under review are obtainable from the Secretary, Indian Central Cotton Committee, Bombay, on payment of Rs. 2 per copy, postage extra.

Potato Growing in Victoria

No. 2. Seed Storage

By J. T. Ramsay, *Potato Expert*

The method adopted for carrying over from harvest to the following planting, potatoes intended for seed is of the utmost importance since the success or failure of the crop depends largely on the treatment accorded to the seed during that period.

So far as storage is concerned, potatoes can be divided into two classes :—(1) those intended for consumption, and (2) those intended for use as seed for the following crops. The correct storage treatments for these two purposes are entirely different. Ventilation is essential to the successful carrying out of both but, in addition to ventilation, potatoes intended for seed must have light as well, whereas potatoes intended for consumption must be kept from the light.

Light has a curious effect on potatoes. Solanum is developed, and the skin and flesh of the tubers turn green—the longer the exposure the

deeper the green. This greening is effected to the very centre of the potato and is not confined merely to the surface layer of flesh. In this green condition the tubers are bitter to the taste and actually poisonous —in fact, stock have died through eating green potatoes to which they have had accidental access.

Let us consider first the storage of potatoes intended for use as seed. It is essential that these be stored in such a way as will preserve them in sound condition during the period from harvest to next planting time and the only way to do this is to subject them to a storage environment which will give them abundance of ventilation and ample light. This essential combination can be effected in several ways, some of which are :—(*a*) by storing them at very shallow depths, not more than two or three tubers deep, on racks or shelves in the open ; (*b*) by placing them in similar manner inside a shed ; and (*c*) by storing them in speically constructed seed potato boxes. Each of these methods produces the same condition, that is, the seed tubers are permitted the amount of ventilation, and the amount of light, requisite for their sound keeping. I want to stress the necessity for this ventilation and light during the storage period of seed potatoes because it is most important. Consider for a moment what happens when seed is subject to storage conditions under which it is denied a sufficiency of ventilation and light. Before many weeks, tubers so stored start to sprout because of the higher temperatures created by natural sweating, and maintained by lack of ventilation. Long before they are required for planting the tubers are overshot with long sprouts, which because of lack of light, are white and intensely brittle. Such sprouts not only have a most exhausting effect on the parent tubers, but they are also incapable of withstanding without damage the handling incidental to planting. The effect of this is that the bulk of them are broken off, and devitalized seed results.

A fairly common practice amongst growers who do not adopt correct storage methods is to break off all sprouts which may be growing from the tubers at the time of planting. This is a certain error. The object of such growers, of course, is to secure some uniformity in the appearance of the crop when it shows through the ground, but the seed suffers irreparably. When desprouting is practised the seed tubers are set back some weeks in their growth and are devitalized to the extent of the nourishment expended in producing the sacrificed shoots. It may be contended, of course, that the sprouts are sometimes too long at planting time to permit the seed to be handled without breaking them. If the seed has long shoots the owner's system of storage is very much at fault, and he should adopt proper storage methods.

Now, let us consider what happens when the seed is given ample ventilation and light. First, the ventilation has the curious effect of concentrating the flow of sap through the channel leading to the terminal bud so that, in the large majority of cases, only one sprout is developed, that of the main eye at the rose end of the potato. This concentration of the whole of the sap of the seed set towards feeding one sprout instead of half a dozen has the effect of giving a much stronger bud or sprout and, consequently, the plant gets a much better start in the season. In this connection it should be noted that, for the first two or three weeks of its life in the ground the young plant is totally dependent on the seed set for its nourishment, *i.e.*, up to the time when the roots which develop at the base of the sprouts are capable of functioning and absorbing the plant foods contained in the soil.

The effect of light on the potato is to develop solanum during which process the skin and flesh of the tuber are turned green in colour. This "greening" process, as it is called, is highly beneficial, as it produces a flesh-hardened condition which enables the potato seed in storage to withstand the attack and arrest development of fungus, bacterial, and insect troubles. This, in itself, is of great importance from the purely economic point of view, since it reduces to a minimum loss during storage. The saving effected by the greening of seed has been estimated by growers at from 25 to 60 per cent. The action of light on the sprouts themselves is no less beneficial. Firstly, it suppresses the growth of the shoot and prevents it reaching an excessive length. Secondly, it greens the sprout as it grows. This greening of the sprout has the effect of toughening it to such a degree that it is capable of standing fairly rough treatment without breakings—a very desirable feature. The importance of that point, *i.e.*, the preservation of the first shoot, is considerable, as will be understood from the following:—

If, when a potato sprouts, that sprout is broken off, in the majority of cases it will sprout again, but the second growth will be weaker than the first. Further, if desprouting is continued the time soon comes when the potato so treated is incapable of responding to the repeated demands on its progressively decreasing vitality. From this it may be easily understood how advisable it is to maintain the first sprout undamaged and the vitality of the seed unimpaired. Mention has been made of various methods of storage that will produce the desired condition. Of those mentioned undoubtedly the most efficient and economical in the long run, is that of storage in seed-potato boxes. They are procurable from any of the case-making firms in Victoria. Some reasons why the boxing system is preferable to others producing similar effects are :

(1) space is economized ; (2) the seed may be inspected and moved with convenience ; (3) the seed is more easily protected from frost and stock ; and (4) less handling of seed is entailed. When seed is stored in pits or heaps, the potatoes cannot be conveniently examined from time to time ; the sprouting cannot be regulated, and the sprouted potatoes cannot be handled from the heaps or pits without injuring a large percentage of shoots, thereby adversely affecting the sets. When seed is stored in boxes the sprouting can be regulated by the admission or the exclusion of light and the tubers can be carted to the paddock and planted without damage to the sprouts.

If no potatoes are stored in seed-boxes directly after digging, and therefore kept well ventilated, in the majority of cases only one shoot will grow from the terminal butt of each tuber; whereas, if stored in pits, or heaps, shoots will grow from almost every eye. The crop resulting from a potato planted whole, with only one eye sprouted, will give a heavier yield of marketable-sized tubers per acre than will a potato of similar size which has shoots at every eye. Seed sprouted nicely before planting will be ready for digging several weeks earlier than will unsprouted seed, and therefore the risk of attack by disease is decreased. When seed has sent forth a shoot prior to being placed in the ground, the grower can see clearly the vigour or weakness of each individual tuber, and can avoid planting sets which would produce weak plants.

In cases where large-sized potatoes are saved for seed, *i.e.*, of a size too large to plant without cutting, it is advisable to green them first either in boxes or otherwise. Then, in order to stimulate bud growth from more than one "eye", they should be covered to prevent ventilation until such time as the shoots are just showing. At this stage the covers should be removed, and the greening of the buds permitted without restriction. The reason for this special treatment of over-sized seed is that it is inadvisable at planting time to make more than one set from any tuber which has only one "eye" sprouted. If this be done there is the danger that the cut section or sections which have no sprout showing will be barn, with consequent misses in the crop.

An interesting illustration of the increased yield resulting from the proper storage of seed potatoes is furnished by the experience of a South Gipps land grower a few years ago. Portion of the seed saved from a crop of the "Up-to-date" variety was boxed, *i.e.*, was stored in seed-potato boxes from May until December. Another portion for the seed from the same crop was stored from May to November in bags. In November, when the seed stored in bags was planted, it was found that

all the tubers had sprouted from every eye. Those tubers which were considered too large to be planted whole were cut for the most part into two sections. In December the potatoes which had been stored in boxes were planted whole, as the majority of them sprouted only from the main eye. The manure used with each lot of seed was the same, *viz.*, 2 cwt. superphosphate per acre. The soil in which they were planted was apparently of the same quality throughout, and the preparation and intercultivation given to both lots also were identical. Owing to the fact that the boxed seed was not cut, a greater weight per acre of these were planted. The rates of seeding per acre were—boxed seed, 1 ton per acre ; bagged seed, 16 cwt. per acre. Although the boxed seed was planted about one month later than the other, both lots matured at the same time, and when dug gave the following yields :—boxed seed, 13 tons per acre ; bagged seed, 8½ tons per acre. These were sold at £ 5 per ton on rails, and a simple calculation shows that the boxed seed returned fully £ 20 per acre more than that portion of the seed which was not boxed.

At the main potato experimental station conducted by the Department of Agriculture at Millbrook, on the Ballarat line, for the four years 1927-28 to 1930-31 inclusive, the average increase in favour of boxed seed as compared with seed stored in bags is not less than 2 tons 9 cwt. per acre, equal to 102 per cent. This surely is adequate proof of the higher efficiency of proper storage.

It may be mentioned here that, provided protection from frost be given—and this is required only in the portions of the State of higher altitudes—seed is best stored out in the open air.

The best proof of the economic soundness of any system is a practical demonstration of the enhanced profit accruing from its adoption.

The boxing of seed potatoes is continually advocated by this Department, and the results of experiments carried out in various parts of the State shows that the use of boxed seed results in substantially increased yields. The actual figures for these tests are :—

	Average seven years.	
	Tons.	Cwt.
Yield from boxed seed	6	9
Yield from bagged seed	3	10
Average increase	2	19

Percentage Increase, 85 per cent.

—*Journal of Agriculture, Victoria*, Vol. XXXI, No. 4.

(*To be Continued.*)

The Soy Bean as Human Food.

By Louis A. Hansen.

Considerable attention is now being given to the value of the soy bean as an economical and efficient article of human diet. Its nutrient properties are wonderful. Its adaptability to various food uses are unusual. Its availability and low cost are of important consideration. We are pleased to have authentic information from those so well qualified to give it as Dr. Horvath and Professor Morse.

The use of the soy bean is traced back about 5,000 years, mention being made of it in Chinese materia medica, written in 2838 B.C. Since time immemorial it has been the most universal article in the Chinese dietary. It is extensively used for food in Korea, Japan, Indo-China, the Philippine Islands, the Dutch Indies, Siam, and India. The Chinese make practically no use of dairy products, and most of the people consume a meagre amount of meat. The soy bean appears to have furnished a remarkably well-balanced diet, through all the centuries. Probably the Chinese nation can well attribute its existence to the soy bean. Contrary to popular opinion, the Chinese do not live on rice. It is quite freely used only in South China, and there the diet is mixed with soy beans.

The soy bean seems to be wrongly named, for it is so different from the ordinary bean that it is not a bean. It has nearly 40 per cent protein, while other beans, navy and Lima beans, have only 20 per cent protein. The soy bean protein is the only known vegetable protein of full biological value, which means it can be used instead of meat, eggs, and milk protein, thus making a vegetable diet a sufficient one. The soy bean contains 20 per cent of oil, while the ordinary bean has practically no oil.

The soy bean protein is complete, with all the essentials to growth and normal development. It was found at the laboratories of Dr. Sherman, of Columbia University, that the human organism retains more nitrogen from soy bean protein than from meat protein, with an evident preference to the soy bean protein.

Chinese Buddhist monks never eat meat, because of religious prohibition. Chinese children are given "soy bean curd" instead of milk or meat, and they grow to normal development. Studies by medical men in China show that the skeleton and organism is developed absolutely normally, and that the Oriental is no different in development from the Occidental.

The soy bean is rich in phosphorus and in a certain substance, lecithin, a necessary constituent for building the human nervous system.

Dr. Levine, of the Rockfeller Institute of New York, found another nerve building substance, cephalin, a constituent of the human brain.

The soy bean is peculiar in being physiologically alkaline. Cereals are acid producers. Hard exercise and muscular work give increased acidity in the blood and tissues. Studies made by Osborne and collaborators at St. Barbara's Hospital show that after a meal of soy bean the alkalinity of the blood is increased, a valuable consideration where the alkalinity of the blood must be increased.

The soy bean contains almost all the vitamins A, B and D (the growth-promoting and antipellagric factors) and E. Vitamin C is present in soy beans after they are soaked in water and sprouted. The soy bean, then, is a food with twice as much protein as beef, of high biological value, 20 per cent oil, of alkaline ash, and all the vitamins.

The oil of the soy bean is of superior quality. Dr. Mendel and collaborators, of Yale University, fed groups of rats on a high fat diet, cocoanut oil and other oils. The rats fed on cocoanut oil were inactive and lazy and spent the day and night sleeping. They had access to revolving cages, into which they would go for a few minutes and then go to sleep again. The rats fed on soy bean oil rushed into the revolving cages, and ran sometimes for ten hours without interruption. This went on for ten days with good conditions and normal sleep by day. Soy bean oil imparted an amazing amount of energy.

A number of scientists have shown that 95 per cent of soy bean oil can be digested and absorbed. The improved methods of refining oil insure a very desirable product. It is excellent as a salad oil as well as for general culinary uses. It is a good substitute for the animal fats. Where there is a world shortage of olive oil, soy bean oil is substituted for it to the extent of sometimes as high as 90 per cent while soy bean oil was formerly used for cooking purposes by a few Chinese only, it is fast coming to the front of the world's market as a foodstuff.

Soy Bean Flour.

Since a way has been discovered to make soy bean flour without the strong, heavy flavour, it is finding use among bakers as a constituent in all kinds of baking-bread, rolls, and pastry. It has a slightly sweet flavour, somewhat like that of crushed nuts. It is rich in fat and protein, contains lecithin, and the vitamins A, B and D. It contains about three and one-half times more protein and approximately sixteen times more fat than wheat flour.

Because of its extreme high protein content and its rich oil values, soy bean flour gives a richness and smoothness to the foods in which it

is used. It keeps well without becoming rancid. Usually 15 per cent soy bean flour is used in bread which gives twice as much protein as would all-wheat flour. One-fourth soy bean flour may be used.

The use of soy bean flour gives bread a good texture, light golden (yellow) interior, and dark brown crust. It should be baked more slowly and for a longer time than all-wheat flour bread. Gems, biscuits, muffins, cakes, cookies, pancakes, mush, croquettes, etc., can be made.

Being so rich in fat, about 20 per cent soy bean flour does not require as much shortening as is generally used. Neither does it need the amount of milk usually used, as it contains, the same amino acids found in cow's milk. Because of its lecithin, less eggs can be used. It has high absorption power, three times that of wheat flour, so it takes more water. This adds to the keeping qualities of the baked product.

Some companies add 25 per cent soy bean flour to their chocolate, making it more nourishing, richer in vitamins, and with better keeping qualities. Soy bean flour is also used in ice cream, to give it better taste, make it smoother, and for better keeping qualities.

In Italy, soy bean flour is added to the rations of the army, and bread containing 15 to 20 per cent soy bean flour is made.

Premier Mussolini has ordered a study of soy bean food values. There is a special Soy Bean Research Institute at Moscow, Russia. An exhibition was shown of soy foods, with 130 varieties of soy dishes, including cutlets, pastry, salads, candy and beef substitutes. A dinner, prepared entirely of soy beans, was served to representatives of trade unions, factories, Red Army, and Soviet Press. The food was unanimously pronounced excellent.

The Soy Bean Milk.

The soy bean protein is not only equal in biological value to the casein of milk, but is similar in properties. It belongs to a group of globulins, which are similar to the casein of milk. The Chinese soak the soy beans overnight, grind them between millstones, and obtain a cream. This cream is diluted with water, and boiled after being filtered through cheesecloth. This yields a milk similar to that made from sweet almonds. The soy bean milk contains oil and the protein necessary to emulsification.

Soy bean milk, if kept at even temperature for hours, will turn acid and coagulate. Curds are formed exactly as curds are formed in ordinary milk. The Chinese make a curd which resembles cheese, and can be cut like cheese. They call it "the meat without the bones". Its chemical composition is very similar to beef. It contains only a very slight amount of purin bodies. Gout is rare in China.

Soy bean milk, if prepared from one part of soy beans and five parts of water, is equal in protein to cow's milk. Scientific studies in Europe and this country show that this milk is very easily digested, from 95 to 100 per cent and that soy bean milk curd, and flour are very excellent foods for children suffering from summer diarrhœa, when they cannot tolerate other foods. It is easily digested, does not irritate the stomach and intestines, and so can be used in a number of conditions, and is recommended by a number of medical authorities. Since it does not contain much starch, 1 per cent, it is the ideal food for diabetics and is used by physicians in Europe and America.

Experiments at the Children's Hospital at Boston Medical School showed that in a number of cases of eczema and asthma where babies could not tolerate any milk and were given food in which the protein was supplied from the soy bean, the eczema disappeared and they developed normally.

Soy Sauce.

Orientals add to the soy bean curd a soy sauce made from cooked, crushed soy beans, table salt, and water. The mixture is kept in big jars in the open air—sometimes covered—up to six months and even five to six years. Through bacterial action, fermentation takes place, with certain changes in the protein that give a resultant product with the taste of beef extract.

Soy sauce is now made in this country under the most sanitary conditions. It is a dark liquid with a pronounced flavour, that makes a little go a long way in giving that tasty protein flavour. It is finding wide use among the best chefs for giving piquancy to various foods. It is even added to meats to accentuate their flavour.

Soy sauce is not a condiment. Professor Abel, of John Hopkins, and a number of other investigators found this sauce to contain substances which stimulate the digestion and absorption of foods, that of carbohydrates from 16 to 32 times, and the digestion of proteins by the pancreatic juice from four to eight times. So it seems that its use by the Orientals is not a matter of taste alone, but one of natural instinct. Chinese farmers work all day without food, eating but one meal and that at night. They use soy sauce freely with this heavy meal, and seems to be able to digest and assimilate the food without distress or discomfort. We do not advise this proceeding for Occidentals.

There are many varieties of soy beans, most of them best suited for stock feeding and soil improvement. A few varieties are especially suited for food for man. The present low price of soy beans makes it a

most practical consideration for meeting the demand for an economy food that is at the same time efficient in nutrition. This wonder food is destined to fill an important place in human economy and welfare.

Much more might be said about the food values of the soy bean, and doubtless much remains to be learned. A great deal might be said as to the industrial uses now being made of this versatile vegetable. From all that is being said about the remarkable properties of this old-new food, one might fear we are in for soy bean fad. But we might go a long way in the study of natural foods and their values without getting off on a tangent or running to extremes. The soy bean seems to offer plenty of room for such study.—*The Journal of the Jamaica Agricultural Society*, Vol. XXXVII, No. 3.

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